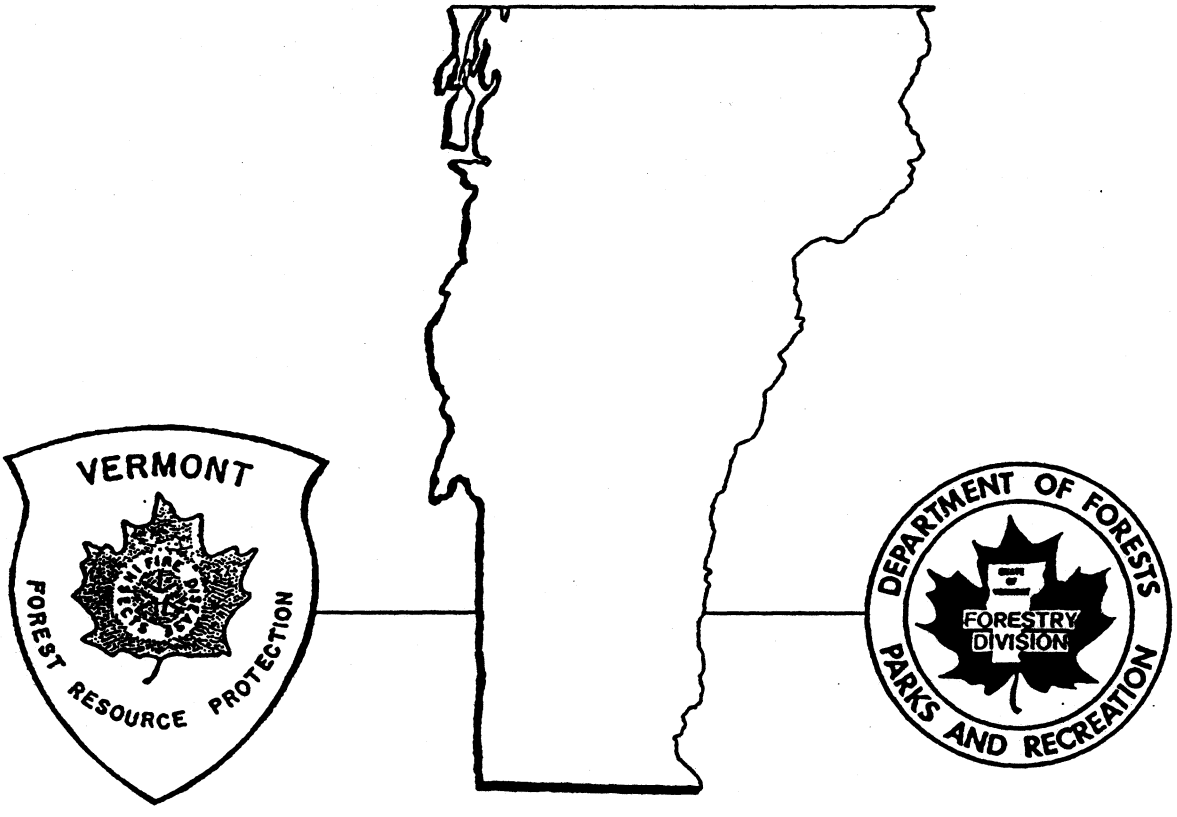
FOREST INSECT AND DISEASE CONDITIONS IN VERMONT 1993



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FOREST INSECT AND DISEASE CONDITIONS IN VERMONT

CALENDAR YEAR 1993

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AGENCY OF NATURAL RESOURCES

DEPARTMENT OF FORESTS, PARKS AND RECREATION

Division of Forestry

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TABLE OF CONTENTS

FOREST RESOURCE PROTECTION PERSONNEL....1

VERMONT INSECT AND DISEASE HIGHLIGHTS....2

VERMONT 1993 FOREST INSECT & DISEASE MANAGEMENT RECOMMENDATIONS....4

VERMONT FOREST HEALTH, INSECT & DISEASE PUBLICATIONS: 1993....6

INTRODUCTION....8

WEATHER AND PHENOLOGY....9

OZONE SUMMARY....13

FOREST INSECTS....14

HARDWOOD DEFOLIATORS....14

BIRCH DEFOLIATION....14

BRUCE SPANWORM....17

FOREST TENT CATERPILLAR....18

GYPSY MOTH....19

MAPLE LEAF CUTTER....20

OAK LEAF TIER....20

SADDLED PROMINENT....23

OTHER HARDWOOD DEFOLIATORS....23

SOFTWOOD DEFOLIATORS....29

ARBORVITAE LEAF MINER....29

FALL HEMLOCK LOOPER....29

SPRING HEMLOCK LOOPER....30

SPRUCE BUDWORM....33

OTHER SOFTWOOD DEFOLIATORS....35

SAPSUCKING INSECTS, MIDGES, AND MITES....38
BALSAM GALL MIDGE....38
BALSAM TWIG APHID....38
HEMLOCK WOOLLY ADELGID....38
OYSTERSHELL SCALE....38
PEAR THRIPS....39
PINE NEEDLE MIDGE....44
SPRUCE SPIDER MITE....44
OTHER SAPSUCKING INSECTS, MIDGES, AND MITES....45
BUD, SHOOT, & STEM INSECTS....51
BALSAM SHOOTBORING SAWFLY....51
OTHER BUD, SHOOT & STEM INSECTS....51
ROOT INSECTS....55
BARK BEETLES....56
FOREST DISEASES....58
STEM DISEASES....58
BEECH BARK DISEASE....58
BUTTERNUT CANKER....62
SCLERODERRIS CANKER....63
SIROCOCCUS SHOOT BLIGHT....63
OTHER STEM DISEASES....63
FOLIAGE DISEASES....69
DOGWOOD ANTHRACNOSE....69
MAPLE ANTHRACNOSE....69
OTHER FOLIAGE DISEASES....69

ROOT DISEASES....72
DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES....73
ASH DIEBACK....73
BIRCH DECLINE....73
DROUGHT....77
FROST DAMAGE....77
HARDWOOD DECLINE....77
SPRUCE MORTALITY....78
WET SITE....83
WHITE PINE NEEDLE BLIGHT....83
WIND DAMAGE....83
WINTER INJURY....84
OTHER DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES....90
ANIMAL DAMAGE....93
TRENDS IN FOREST CONDITION....95
NORTH AMERICAN MAPLE PROJECT....95
TAKE A PLOT....97
HEALTH OF SUGAR MAPLE IN VERMONT - 1993....98
COMMON PESTS OF CHRISTMAS TREES IN VERMONT - 1993....100

DEPARTMENT OF FORESTS, PARKS AND RECREATION
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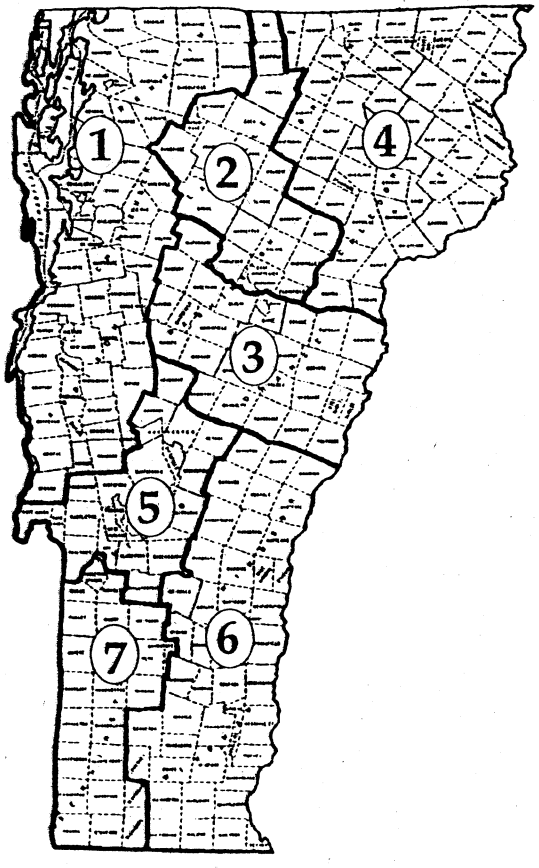

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	Tom Simmons	879-6565 (B)
	Essex Jct.	862-0282 (R)
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3.	Jay Lackey	479-3241 (B)
	Barre	476-8125 (R)
4.	Hollis Prior	748-8787 (B)
	St. Johnsbury	684-2276 (R)
	John St. Arnauld	748-8787 (B)
	St. Johnsbury	748-2446 (R)
5.	John Barrows	483-2314 (B)
	Pittsford	746-8340 (R)
6.	Allan Sands	886-2215 (B)
	N. Springfield	875-2279 (R)
7.	Nate Fice	362-5533 (B)
	Manchester	447-1929 (R)

Vermont
Insect & Disease Highlights
1993

Arborvitae Leaf Miner caused widespread browning, with over 200 acres heavy enough to be detected in aerial surveys.

Ash Dieback and thin crowns were unusually common. Many of the new symptoms were attributed to heavy seed production in 1992, with the additional stresses of widespread frost injury the same year, and low winter temperatures. Ash yellows remains common.

Balsam Gall Midge populations remain low, with no damage expected in 1994.

Balsam Shootboring Sawfly caused light to moderate mortality on balsam and fraser fir Christmas trees.

Balsam Twig Aphid damage occurred throughout the state. Populations appeared to be crashing by mid-summer.

Beech Bark Disease caused noticeable chlorosis to beech throughout the state, with 2290 acres mapped from the air. Levels of scale and nectria have increased slightly in monitoring plots.

Birch Decline and mortality were mapped on 1150 acres, particularly at higher elevations.

Birch Defoliation was widespread, with damage up from 1993, and close to 1991 levels. Damage was mapped on 23090 acres. and was heaviest in the eastern counties and at higher elevations. Damage was caused by birch leaf miner and birch skeletonizer.

Bruce Spanworm caused widespread early season defoliation to sugar maple, with some heavier damage to scattered sugarbushes in eastern and central Vermont.

Butternut Canker was confirmed as being present throughout the state. Cultures from samples collected in every county were positive for the fungus.

Dogwood Anthracnose was confirmed to be present in Windham and Bennington, the only two counties where native flowering dogwood is known to occur.

Drought Conditions in late spring and early to mid-summer led to scattered problems in southern Vermont.

Fall Hemlock Looper caused only light defoliation, although moths have been common statewide since 1991.

Forest Tent Caterpillar populations continued to be very low.

Frost Damage was much reduced from previous years.

Gypsy Moth populations remained low, with no defoliation detected, and none expected in 1994.

Hardwood Decline symptoms were mapped on 80930 acres. Most of the damage was scattered dieback in stands also damaged by pear thrips.

Hemlock Woolly Adelgid was not observed either in statewide detection efforts or during surveys of the site where it was introduced in 1990.

Maple Anthracnose was mapped in scattered locations in the Champlain valley.

Maple Leaf Cutter defoliation was mapped on 2950 acres in eastern and central counties, with generally lighter damage than 1992.

Oak Leaf Tier larvae or damage were not observed.

Oystershell Scale was less evident this year, although thin crowns associated with past or current infestations were occasionally observed.

Pear Thrips damage was mapped on 84,000 acres in northern Vermont, with over half of that acreage in Lamoille County. Heavily damage trees refoliated rapidly, but moderately damaged trees retained their stunted leaves. Low soil counts from late fall indicate that damage will be lower in 1994.

Pine Needle Midge damage to Scots pine Christmas trees increased.

Saddled Prominent populations continue to decline with only occasional larvae observed.

Scleroderris Canker was not found in any new towns for the seventh consecutive year.

Sirococcus Shoot Blight was less noticeable in plantations where the disease was causing shoot mortality in 1992.

Spring Hemlock Looper defoliation was not observed. Dieback and mortality is continuing from defoliation in 1990-91, including 690 acres which were mapped from the air.

Spruce Budworm populations remain low, with no defoliation detected.

Spruce Mortality was mapped in scattered locations, mostly at high-elevations.

Spruce Spider Mite caused occasional heavy damage. High numbers of overwintering eggs are present in some locations.

Wet Site Conditions caused scattered mortality, which was mapped on 9060 acres, mostly associated with Lake Champlain and its tributaries.

White Pine Needle Blight symptoms from 1992 remained visible, but no new damage was observed.

Wind Damage, from severe storms, was heavy in scattered locations in Orleans, Essex, Caledonia, and Chittenden Counties.

Winter Injury to red spruce, attributed to extremely low temperatures in February, was mapped on 44,300 acres. However, bud development was normal on most affected trees.

Vermont
1993 Forest Insect & Disease Management Recommendations

The following recommendations summarize information in this report of particular importance to forest managers. Additional information can be found under specific pests mentioned. Separate summaries for sugarbush and Christmas tree managers are in the appendix.

For assistance in identifying pests, diagnosing forest health problems, on-site evaluations, and insect sampling, or to obtain copies of defoliation maps, management recommendations, and additional literature, contact forest resource protection personnel (page 1) or your county forester.

Sugar Maple - Damage by pear thrips was heavy in parts of northern Vermont. Because of adequate moisture, most heavily damaged stands refoliated rapidly, and the impact on otherwise healthy trees should be temporary. Where trees were moderately damaged, and retained small, misshapen leaves all season, the impact is likely to be more severe. These stands should be given two or three years to recover before any selective harvesting is done.

Maple leaf cutter remained a problem, particularly in the east-central counties where it has been heavy for several years. Less severe damage in 1993 may be due to declining populations, or to cool weather conditions during egg-laying. Stands which have been defoliated for several consecutive years should not be disturbed.

Elsewhere, sugar maples were generally healthy, with adequate moisture throughout the growing season.

Bruce spanworm moths were common in the fall, and some early season defoliation by this insect may occur in 1994. Otherwise, populations of major defoliating insects, including overwintering thrips and defoliating caterpillars, are low statewide.

Birch - Defoliation was widespread, for the third consecutive year. Damage was common on both white and yellow birches. Although this browning, caused by both birch skeletonizer and birch leaf miners, reaches its peak late in the season, the cumulative impact of successive defoliations may lead to tree decline. This is particularly true of trees which are already under stress. Defoliated birch stands and those with light dieback should be allowed to recover by avoiding additional disturbance. Trees with heavier dieback, generally those with 20% or more dead branches in the live crown, are unlikely to recover.

Beech - Beech bark disease remains stable, causing areas of scattered dieback and chlorosis. Continue to manage this species by favoring resistant individuals in the residual stand. These are individuals which may remain smooth barked, while other trees in the general area have defective stems.

Oak - There were no major problems on oak in 1993. With gypsy moth populations expected to remain low, now is a good time to schedule selective harvest cuts which may have been delayed due to the past outbreak.

White Ash - Ash dieback was common in 1993. Ash yellows continued to be a cause of dieback in many areas. Where symptoms were new in 1993, the dieback and thin crowns were often related to heavy seed production in 1992. These trees had persistent seed petioles, and the most severe dieback in the mid-crown. Because the symptoms on these trees are related to a single event, most are expected to recover. Do not rush to salvage these trees, but re-evaluate them in 1994.

Trees which had symptoms prior to 1993 are more likely to be affected by ash yellows. The presence of witch's brooms is diagnostic for the disease. Other symptoms which may indicate ash yellows are tufted foliage, dieback most severe in the upper crown, deliquescent branching, and frost cracks. Although some trees can tolerate ash yellows, those with conspicuous symptoms should be salvaged, as the disease can progress rapidly.

Spruce-Fir - Winter injury to red spruce was widespread, particularly at higher elevations. In most situations, bud development occurred normally, and trees are expected to recover. Episodes of winter injury occur periodically to red spruce, and may be related to some of the high elevation spruce decline in the state.

Spruce budworm populations remain low. Treatments which reduce the component of older balsam fir will make stands more resistant to future outbreaks.

Hemlock - No new defoliation by hemlock looper occurred this year. Mortality is continuing in some of the stands which were severely defoliated in 1991, but many trees are recovering. This suggests that in many stands, salvage can be postponed until the fate of affected trees is clearer.

Hemlock woolly adelgid remains of concern, although it has not progressed any closer to Vermont in the past few years. Quarantine regulations prohibit the movement of hemlock logs from infested areas into Vermont, except if they are being shipped to pre-approved sites. Salvage in anticipation of hemlock woolly adelgid is not currently recommended, as the infestation has not been advancing, and infested trees generally declined over an extended period.

Butternut - Butternut canker was confirmed as present throughout Vermont. To improve the opportunity for the survival of potentially resistant individuals, we recommend retaining butternut trees particularly those which are not cankered or which have only limited dieback.

VERMONT FOREST HEALTH, INSECT & DISEASE PUBLICATIONS: 1993

For copies of the publications listed below, contact the authors or Forest Resource Protection personnel (Page 1).

Bergdahl, D.R., J.R. Bove, P.E. Sendak and D.R. Tobi. 1993. The use of ARC/INFO to determine amounts of decay and merchantable wood in diseased sugar maple trees. Proceedings: Eighth annual Northeast ARC/INFO Users Group Conference. Burlington, Vermont.

Bergdahl, D.R. and S. Halik. 1993. Persistence of *Bursaphelenchus xylophilus* in living *Pinus sylvestris*. Phytopathology 83:(242).

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Brownbridge, M. (in press). Prospects for mycogens in thrips management In: Thrips biology and management Proc from 1993 International Conference on Thysanoptera, Sept. 28-30, 1993, Burlington, VT. Plenum Press.

Brownbridge, M., R.A. Humber, B.L. Parker and M. Skinner. 1993. Fungal entomopathogens recovered from Vermont forest soils. Mycologia 85:358-361.

Curtis, L., and R.S. Kelley. 1993. Forest Canopy Photography: A guide to Field Methods and Image Analysis. A joint VT Agr. Exp. Sta. and State of VT publ. RR68 Univ. VT, Burlington. 32 pp.

Ellsworth, D.S., M.T. Tyree, B.L. Parker and M. Skinner (in press). Impact of pear thrips damage on sugar maple physiology: A whole-tree experiment In Thysanoptera: Towards Understanding Thrips Management. *Eds.* B. L. Parker, M. Skinner and T. Lewis. NATO ASI Series, Pergaman Press, New York.

Ellsworth, D.S., M.T. Tyree, B.L. Parker and M. Skinner (in press). Photosynthesis and water-use efficiency of sugar maple *(Acer sacharrum)* in relation to pear thrips defoliation. Tree Physiology.

Hansen, T., H.B. Teillon and B.S. Burns. 1994 Regional Forest Pest Survey Manual for New England and New York. VT Department of Forests, Parks and Recreation, Waterbury, VT.

Parker, B.L. and M. Skinner. 1993. Field evaluations of traps for monitoring emergence of pear thrips (Thysanopteria: Thripidae), Journal Econ. Ent. 86:46-52.

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Skinner, M., B.L. Parker, W.E. Wallner, T.M. O'Dell, D. Howard and J. Aleong. 1993. Parasitoids in low-level populations of Lymantria dispar [Lep: Lymantriidae] in different forest physiographic zones. Entomophagia 38:15-29.

Vermont Agency of Natural Resources. 1994. Environment 1994. VT-ANR, Waterbury, VT. 15 pp.

Wargo, P.M., D.R. Bergdahl, D.R. Tobi and C.W. Olson. 1993. Root vitality and decline of red spruce. Landsberg am Lech:ecomed (Contributiones Biologiae Arborum Vol. 4.) 134 p.

Wilmot, S.H., B.L. Parker and T.M. O'Dell. 1993. Sampling parasitoids in host-augmented gypsy moth (Lep., Lymantriidae) populations. Journal of App. Ent. 116:62-71.

INTRODUCTION

The information in this report is based largely on aerial surveys to detect forest damage, as well as ground surveys and observations of VT Forestry Division staff.

Three aerial surveys were flown in 1993. The first one was in early May to map the extensive winter browning of red spruce. The second survey was conducted in late June to early August to detect pear thrips damage and other early season defoliators. The last survey in early to mid-September targeted defoliation by maple leaf cutter and birch defoliators.

A survey is conducted annually on nearly 400 acres of Christmas tree plantations in North-Central Vermont as part of the Scleroderris quarantine. Observations are made on all pests during this survey. Acreages reported for Christmas tree problems refer to changes in these surveyed plantations and are not statewide totals.

Diagnostic assistance was provided by the Division of Forestry Diagnostic Laboratory, University of Vermont, the Vermont Department of Agriculture, the Maine Forest Service, and the US Forest Service.

Thanks to the many individuals who contributed to this report, including Trish Hanson, Sandy Wilmot, John Barrows, Hollis Prior, Jay Lackey, Pete Reed, Tom Simmons, Bernie Barton, John St. Arnauld, Allan Sands, and Nate Fice from our Forest Resource Protection Staff, Dale Bergdahl, Margaret Skinner, and Dave Ellsworth from the University of Vermont, and Jon Turmel and Scott Pfister from the VT Department of Agriculture. Assistance in preparing maps and survey acreages was provided by Diane Morse and John Dudley from the VT Agency of Natural Resources and Tom Luther and Bob Cooke from the US Forest Service, Forest Health Protection. A special thanks to Melissa Currier for preparing the manuscript.

WEATHER AND PHENOLOGY

Winter began with little snow. January temperatures were warmer than average. Extreme cold occurring in February led to widespread desiccation of conifer foliage. Snow was plentiful in mid-late winter.

Spring started out wet due to heavy snow melt and above normal precipitation in April. Lake Champlain flood waters from spring snow melt hit record highs (101.88' on April 26, the highest since 1903).

Spring also began late, but warm weather in late April and early May caused budbreak of maples, and other early species, to progress quickly. This was followed by consistently below normal temperatures in late May which slowed foliage development on sugar maples in northern Vermont, contributing to some heavy pear thrips damage, delayed the growth of white ash foliage statewide, and led to some fungus diseases. There was little damage from spring frosts.

Precipitation was below normal in May and near normal in June. Dry conditions in late spring and early-mid summer led to drought stress, in some areas of the state, particularly where trees were growing on poor sites. The weather became cooler and moister in late summer. July and August had above normal precipitation in north central Vermont from frequent, late afternoon thunderstorms (Table 1). Violent weather associated with severe thunderstorm activity blew down trees in scattered locations.

Autumn was generally cool and dry, resulting in brilliant fall colors.

There were particularly heavy seed crops on red oak and white pine. Wild apples were also plentiful, while beechnuts were spotty.

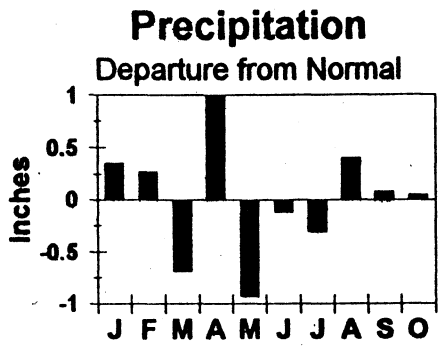
Temperature and precipitation averaged near normal for the entire growing season (April-September), although there were many monthly and regional fluctuations.

Weather conditions are summarized in Table 1 and Figure 1. Phenology is summarized in Table 2 and Figures 2 and 3.

Table 1. North-Central Vermont Precipitation During the 1993 Growing Season[1].

Month	Average Precipitation	Departure From Normal	% of Normal
May	2.55"	- .67"	79%
June	3.50"	+ .23"	107%
July	4.57"	+ 1.21"	136%
August	5.49"	+ 2.12"	163%

[1]Vermont Division of Forestry Stations in Wolcott, Barre, Orange, Randolph, Fairlee, and Worcester.



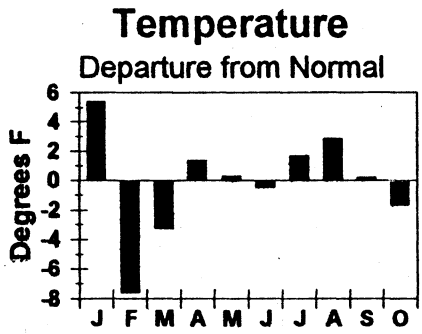
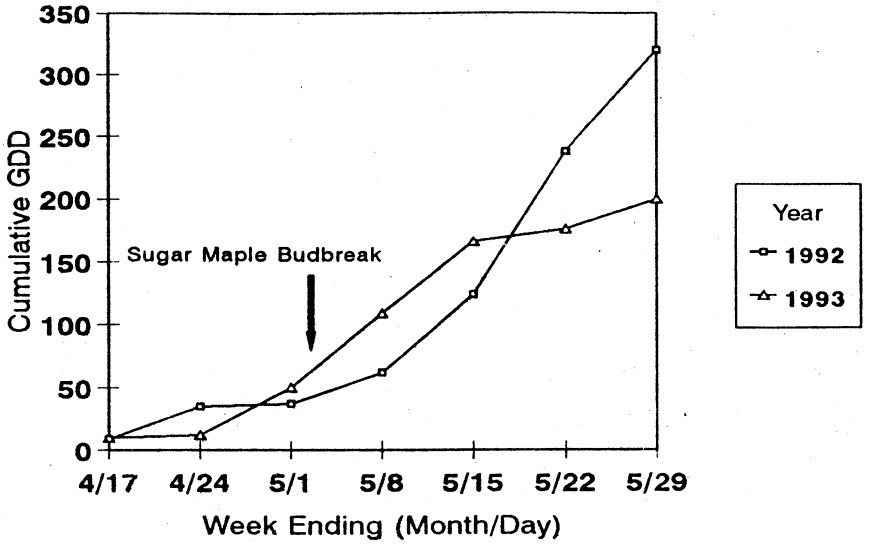


Figure 1. Departure from normal of 1993 precipitation and temperature at Burlington International Airport. Data from NOAA Local Climatological Data: Monthly Summary.

Table 2. 1993 Growing degree day accumulations[1] and observation dates of phenological development in 5 sites in Vermont.

Biological Indicator	Barre	Hardwick	Springfield	Stowe	Underhill
Plant Development					
Showing Green					
Balsam Fir		69 (5/3)		55 (5/3)	73 (5/4)
Fraser Fir		194 (5/21)			
Budbreak					
Black Cherry			40 (5/1)		
Elm		48 (5/1)			
Red Oak			65 (5/4)		
Sugar Maple	76 (5/3)	69 (5/3)	40 (5/1)	51 (5/2)	43 (4/30)
Trembling Aspen			9 (4/4)		
White Ash	181 (5/17)	114 (5/7)	83 (5/5)	119 (5/9)	133 (5/10)
Balsam Fir	131 (5/9)	93 (5/5)		96 (5/6)	91 (5/7)
Fraser Fir		208 (5/24)			
Hemlock			172 (5/14)	164 (5/14)	
White Spruce				109 (5/8)	
Honeysuckle		1 (4/19)			
Lilac		8 (4/21)			
Flowers					
Lilac	163 (5/12)	189 (5/2)	164 (5/12)	190 (5/25)	187 (5/25)
Paper Birch			47 (5/2)		
Red Maple		16 (4/28)		18 (4/27)	10 (4/19)
Shadbush	113 (5/6)	69 (5/3)	40 (5/1)	67 (5/4)	91 (5/7)
Sugar Maple		16 (4/29)			91 (5/7)
Full Green Up			264 (6/3)		
Insect Development					
Eastern Tent Caterpillar Nest	60 (5/1)		54 (5/3)	51 (5/2)	73 (5/4)
Maple Leaf Cutter Adult			121 (5/9)	165 (5/15)	43 (4/30)
Maple Leaf Cutter Mines				464 (6/23)	
Pear Thrips Adult		16 (4/28)	17 (4/29)	18 (4/27)	43 (4/30)
Pear Thrips Larvae		183 (5/17)		165 (5/15)	171 (5/19)

[1] 50 degrees F used as the threshold of development



*50 degrees F used as the threshold of development

Figure 2. Weekly cumulative growing degree days (Base 50) in Stowe, 1992-1993.

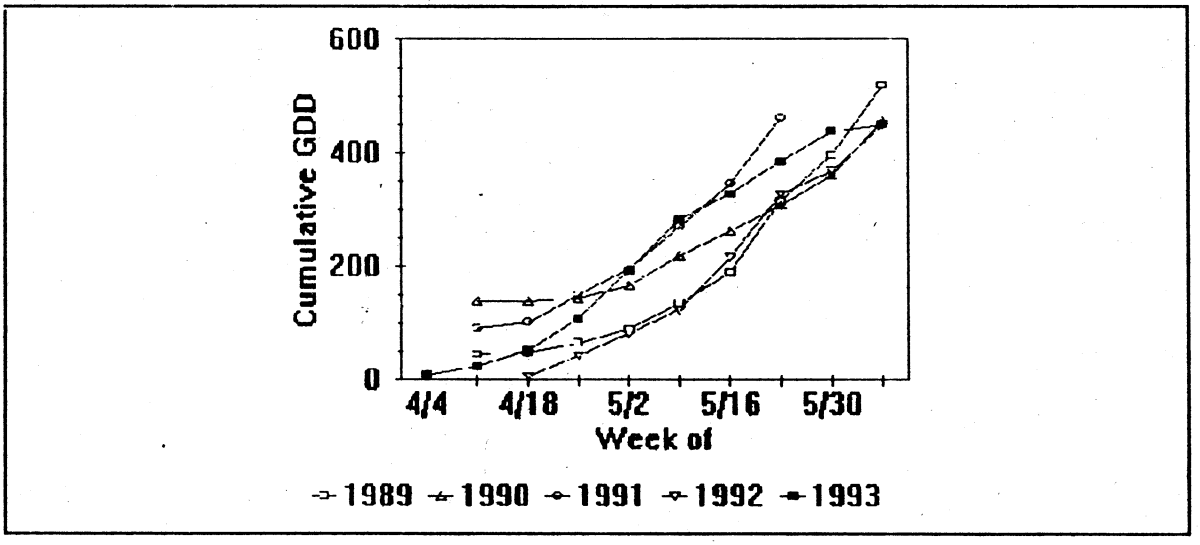


Figure 3. Weekly cumulative growing degree days (86/50 calculations) in Springfield, 1989-1993.

OZONE SUMMARY

Ozone levels measured at Underhill and Bennington were below the National Ambient Air Quality Standard of 0.120 ppm for 1 hour set for the protection of human health (Table 3). Sensitive plant species, including white ash and black cherry, are adversely affected by levels of ozone above 0.060 ppm. At Underhill, there were more hours above this threshold for sensitive species in 1993 than in 1992. Bennington ozone data was very similar between the two years. Both sites had peak concentrations of ozone occurring in late June.

Table 3. Ozone levels recorded during the 1993 growing season at two sites.[1]

Monitor Site	Total Number Hours With		Maximum Concentration[2]		No. of Episodes[3]
	≥ .060 ppm	≥ .080 ppm	ppm	Date	
Underhill	283	29	96	6/25	1
Bennington	289	48	112	6/18	0

[1] Data provided by the Vermont Air Pollution Control Division.
[2] Maximum recorded ozone level in a single hour.
[3] "Episodes" are two consecutive days when ozone levels exceeded 0.080 ppm for at least 2 hours.

An accumulation of ozone throughout the growing season can eventually result in visual leaf injury. Information on how cumulative ozone intake can affect forest productivity is not well understood, but is currently being studied by researchers around the country.

Symptoms of ozone injury on sensitive plants were observed in August both in Underhill and Rupert (southwestern Vermont). However, no ozone damage was detected on forest trees from aerial surveys, nor from leaf collections from hardwood trees on Mount Mansfield.

FOREST INSECTS

Hardwood Defoliators

Birch Defoliation, caused by **Birch Skeletonizer**, *Bucculatrix canadensisella*, **Birch Leaf Folder**, *Ancylis discigerana*, and **Birch Leaf Miners**, *Fenusa pusilla* and *Messa nana*, was widespread again late in the season, with damage up from 1992, and close to 1991 levels. Damage was mapped on 23,090 acres in 1993, compared to 10,200 acres in 1992 (Table 4, Figure 4). Damage continued to be heaviest in the eastern counties, and at the higher elevations. Shade trees in these areas were also affected. About 30% of the foliage of birches was affected in areas mapped as having moderate damage, while 60-90% of the foliage was affected in areas mapped as heavy damage.

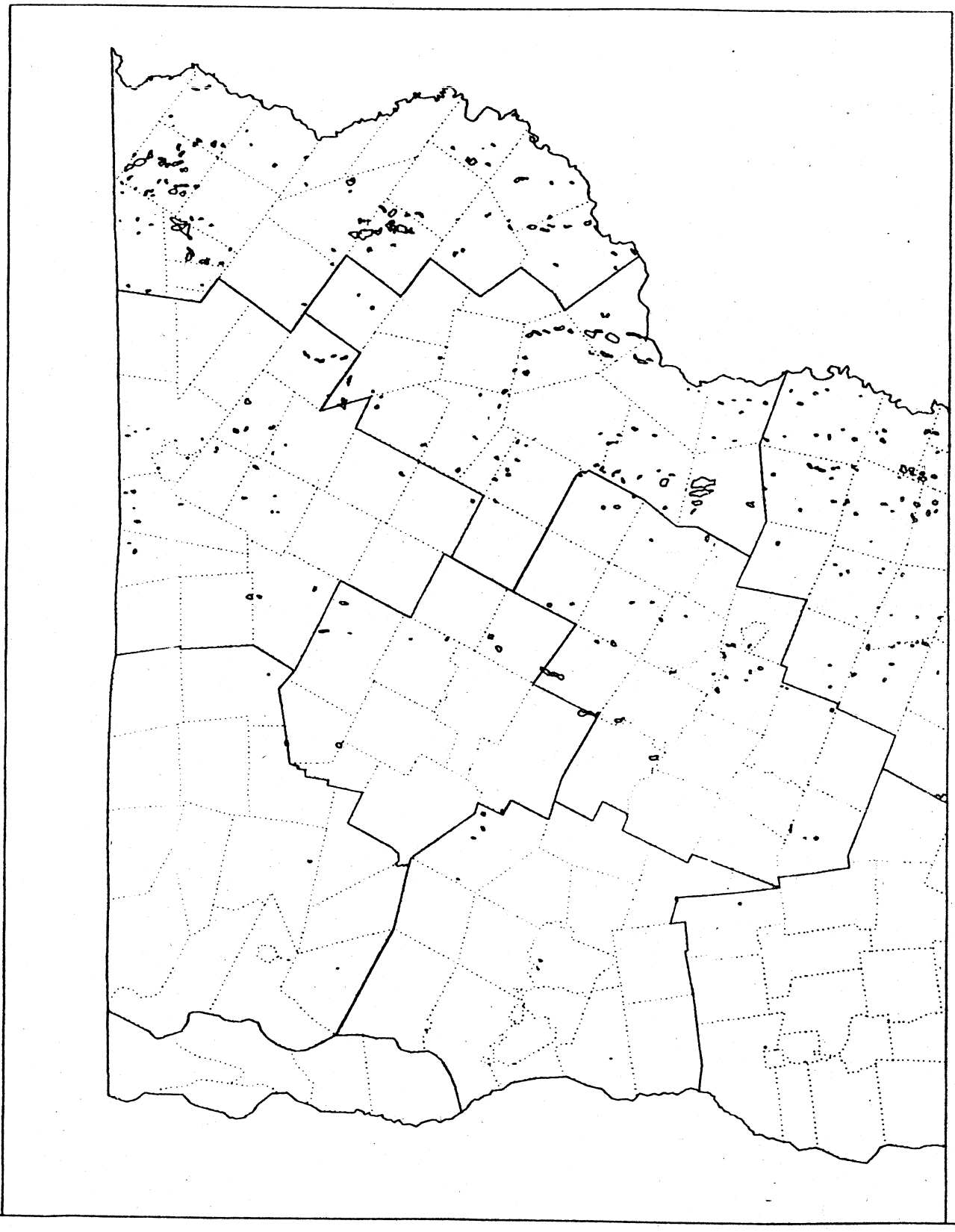
Table 4. Mapped acres of birch defoliation in 1993.

County	Damage Severity		
	Moderate	Heavy	Total
Addison	60	0	60
Bennington	170	0	170
Caledonia	2640	1900	4540
Chittenden	160	0	160
Essex	2480	4040	6520
Franklin	80	0	80
Lamoille	600	200	800
Orange	1940	1960	3900
Orleans	950	130	1080
Rutland	550	0	550
Washington	700	950	1650
Windham	180	0	180
Windsor	3310	90	3400
Total	**13820**	**9270**	**23090**

Most of the damage to both white and yellow birch continued to be from birch skeletonizer, with birch leaf folder and birch leaf miner populations down from 1992. However, birch leaf miner was the predominant defoliator in Addison, Chittenden, Franklin, and Orleans Counties.

Evaluation of yellow birch that was heavily damaged by birch leaf folder continues in Granville Gulf. Defoliation this year was very light (averaging just over 5%, compared to 20% in 1992 and 80% in 1991), and average dieback is 5%.

For a more complete evaluation of the impact of late-season defoliation of birch, which has been widespread since 1991, monitoring plots were established in affected stands throughout the state. See Birch Decline for more information on this survey.



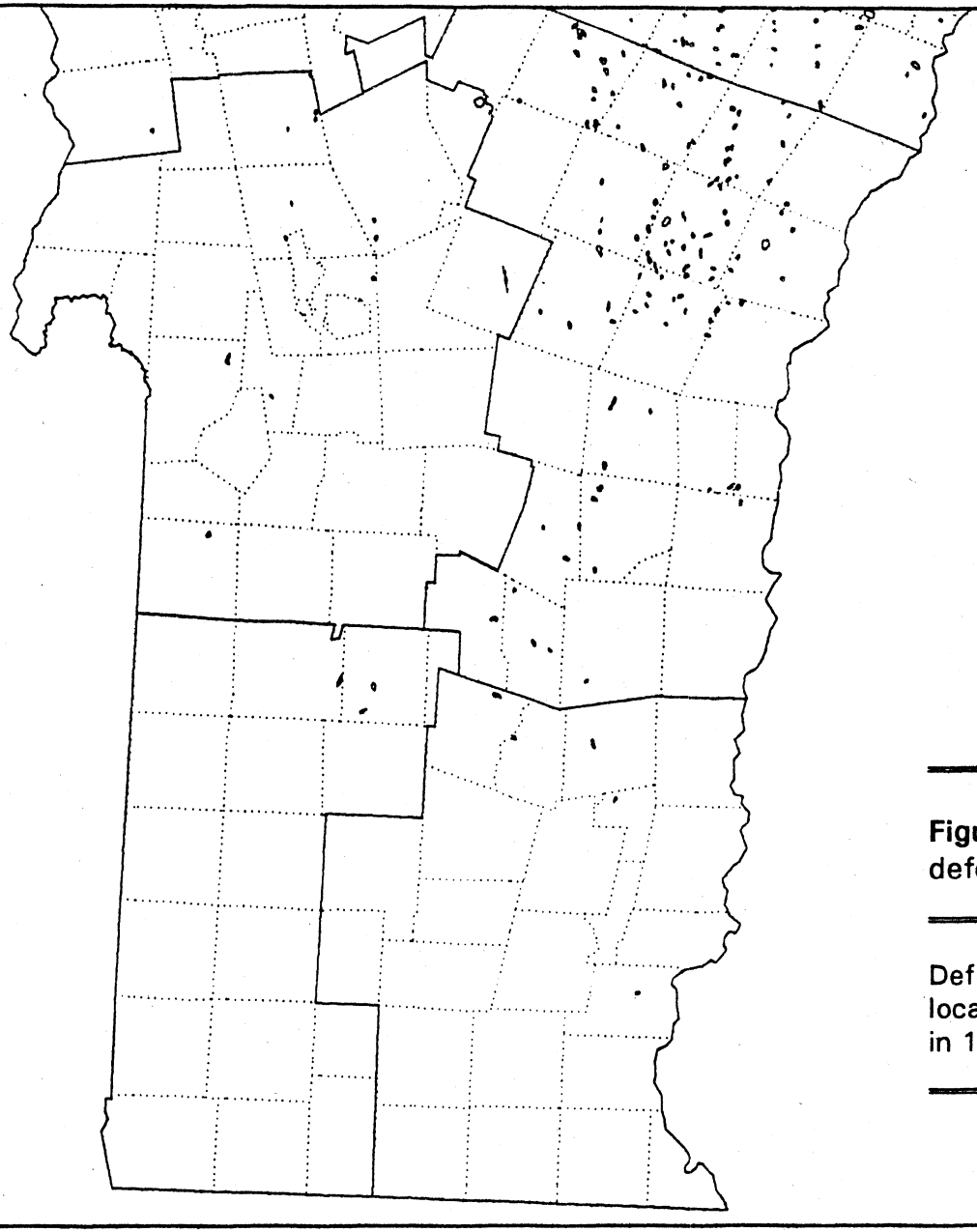


Figure 4. 1993 Birch defoliation.

Defoliation area approximate location. Total defoliation mapped in 1993 = 23,090 acres.

Bruce Spanworm, *Operophtera bruceata*, caused widespread light damage to sugar maple that was more noticeable than in 1992. Moths were more commonly observed in many locations in November than in 1992, indicating that defoliation may increase in 1994.

Some heavy defoliation of regeneration and lower crowns of overstory trees occurred, but defoliation was not heavy enough to detect during aerial surveys. Moderate damage, as observed from the ground, was reported in about 12 sugarbushes, resulting in 790 acres of defoliation (Table 5).

Table 5. Acres of moderate (30-50%) defoliation of sugar maple by bruce spanworm, based on ground observations.

County	Acres
Caledonia	200
Orange	100
Orleans	340
Washington	50
Windsor	100
Total	790

Forest Tent Caterpillar, ***Malacosoma disstria,*** **populations continued to be very low this year statewide. Larvae were observed only occasionally in sugar maple stands and no defoliation was observed. In several locations in southern Rutland county, young larvae were numerous but populations appeared to collapse after the 2nd or 3rd instar.**

Moth catches remain low. No moths were caught in pheromone traps this year (Table 6). Only a few moths were caught in a Luminoc light trap in Hyde Park that combined a blue light source with a pheromone lure. Numerous moths were caught in the Luminoc in the same location in 1992.

Table 6. Average number of forest tent caterpillar moths caught in pheromone traps, 1988-1992.[1]

Location	1988	1989	1990	1991	1992	1993
Roxbury	0.0	0.6	0.2	0.0	0.0	0.0
Waterbury	1.2	3.6	0.0	0.4	0.0	0.0
Waterville	0.2	2.2	0.0	0.0	0.0	0.0
Fairfield	-	0.0	0.0	0.0	0.0	0.0
Bethel	-	0.4	0.2	0.4	0.0	0.0
Sherburne	-	2.6	0.0	0.0	0.0	0.0
Barnard	0.6	-	2.6	2.2	-	0.0
Underhill (VMC 1400)	-	-	-	0.0	0.0	0.0
Underhill (VMC 2200)	-	-	-	-	0.0	0.0
Underhill (VMC 3800)	-	-	-	-	0.0	0.0
Average	**0.6**	**1.6**	**0.4**	**0.4**	**0.0**	**0.0**

[1]Multi-pher traps baited with RPC-2 component lures, 5 traps per location.

Gypsy Moth, *Lymantria dispar*, populations remained low, with no defoliation detected and none expected in 1994. Fall egg mass counts were very low in focal area monitoring plots (Table 7).

Table 7. Gypsy moth egg mass counts from focal area monitoring plots 1986-1993.[1, 2]

Plot Location	1986	1987	1988	1989	1990	1991	1992	1993
Minards Pond	0	0	7	99	10	0	0	0.5
Fort Dummer	2	0	1	1	0	0	0	0.5
Handley Mountain	1	1	4	417	7	2	1	0
Perch Pond	0	115	226	168	1	1	0	0
Rocky Pond	0	6	53	>400	11	0	0.5	0
Petersburg	1	0	1	296	89	51	1	0
Tate Hill	0	0	6	498	5	25	0	0
Arrowhead[3]	5	21	48	96	3	2	0	0
Brigham Hill[4]	10	37	28	74	212	22	0	0.5
Middlesex	0	0	1	19	23	3	0	0
Sandbar	-	45	173	226	57	6	3	3
VMC 1400	-	-	-	-	-	-	-	1
Average	**2**	**20**	**46**	**200**	**38**	**10**	**0.5**	**0.5**

[1] Total number in 15m diameter burlap-banded plots.
[2] Average of 2 or 3 plots in 1986 and 2 plots in 1987-1993.
[3] Aerial sprayed with Bt (Foray) in 1990.
[4] Aerial sprayed with Bt (SAN 415) in 1988.

Maple Leaf Cutter, ***Paraclemensia acerifoliella,*** defoliation was mapped on 2950 acres in eastern and central counties (Table 8, Figure 5). The acreage is down from 3,720 acres mapped statewide in 1992, and the damage was generally lighter. Damage to sugar maple crowns, in five areas mapped as having moderate damage, averaged 21% when evaluated from the ground.

Heavy damage to sugar maple understory was common in widely scattered locations. As usual, the tops of trees had the least defoliation, making aerial detection difficult. Cool weather, when adults were laying eggs, may have helped suppress population levels. This insect has the potential to increase in 1994.

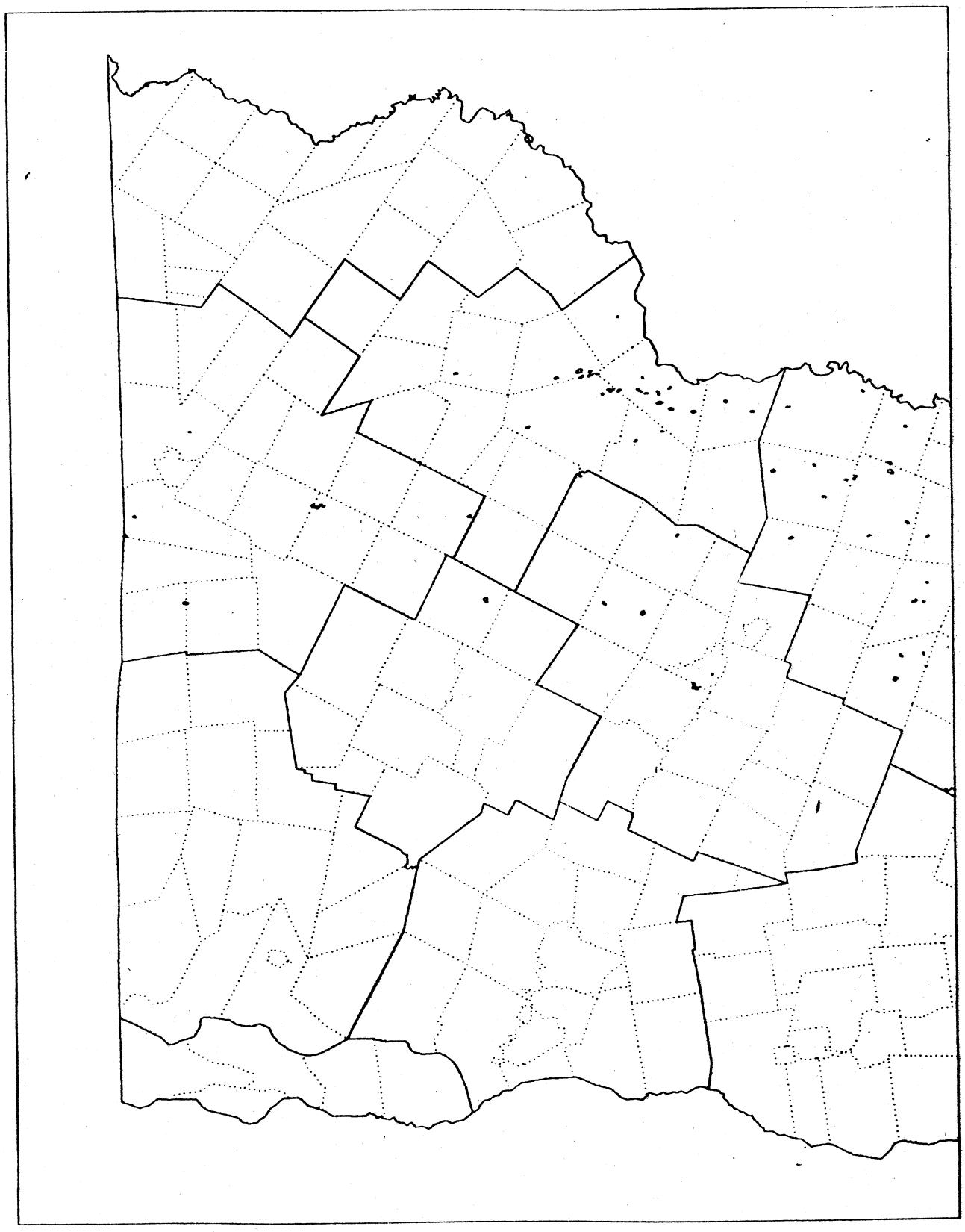
Table 8. Mapped acres of damage by maple leaf cutter in 1993.

County	Damage Severity		
	Moderate	Heavy	Total
Caledonia	350	240	590
Lamoille	0	60	60
Orange	440	450	890
Orleans	120	110	230
Washington	30	180	210
Windsor	960	10	970
Total	**1900**	**1050**	**2950**

Oak Leaf Tier, ***Croesia semipurpurana,*** larvae or damage were not observed. Although no moths were caught in traps in Brattleboro for the 3rd year in a row, and no moths were caught in Rupert for the 5th consecutive year, the number caught in Rockingham increased dramatically (Table 9). This site has consistently had the highest catches, although no defoliation has been observed there.

Table 9. Oak leaf tier moths caught in pheromone traps 1988-1993.

Location	# of Moths/Trap*					
	1988	1989	1990	1991	1992	1993
Brattleboro	40	0	1.3	0	0	0
Rockingham	60	0	1.3	26	0	16.3
Rupert	0	0	0	0	0	0



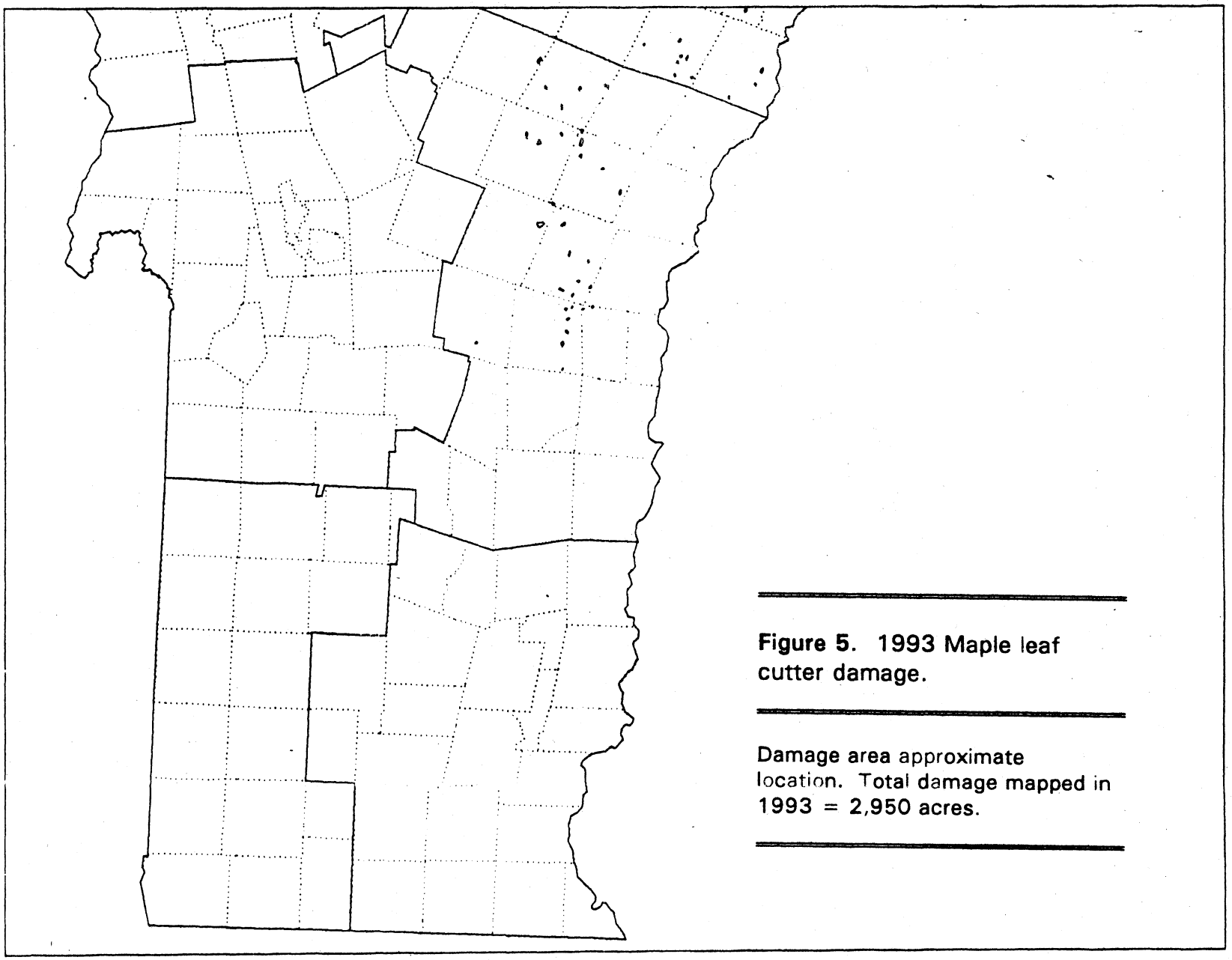


Figure 5. 1993 Maple leaf cutter damage.

Damage area approximate location. Total damage mapped in 1993 = 2,950 acres.

Saddled Prominent, *Hetercampa guttivata*, larvae were rarely observed in northern Vermont and were not observed in southern Vermont, indicating that populations continue to decline. Populations remained low in the monitoring plots in Shrewsbury and Wilmington, where no eggs were observed on ten leaf clusters, compared to none and four, respectively in 1992. Although moths were easily caught in a Vershire light trap, there were no eggs or larvae on the ten leaf-clusters examined in that location.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Alder Leaf Beetle *Altica ambiens alni*			Not observed.
American Aspen Beetle *Gonioctena americana*			Not observed.
American Dagger Moth *Acronicta americana*			Not observed.
Apple Bucculatrix *Bucculatrix pomifoliella*			Not observed.
Aspen Leaf Roller *Pseudoexentera oregonana*			Not observed.
Birch Leaf Folder *Ancylis discigerana*			See narrative.
Birch Leaf Miner *Fenusa pusilla*			See narrative.
Birch Skeletonizer *Bucculatrix canadensisella*			See narrative.
Blackheaded Ash Sawfly *Tethida cordigera*			Not observed.
Bruce Spanworm *Operophtera bruceata*			See narrative.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Cecropia Moth *Hyalophora cecropia*			Not observed.
Cherry Scallop Shell Moth *Hydria prunivorata*	Black Cherry	Chittenden	On regeneration in a clearcut area.
Comma Butterfly *Polygonia comma*			Not observed.
Dogwood Sawfly *Macremphytus sp.*			Not observed.
Early Birch Leaf Edgeminer *Messa nana*			See narrative.
Eastern Tent Caterpillar *Malacosoma americanum*	Cherries Apples	Throughout	Generally light scattered damage around field edges and roadsides.
Elm Leaf Beetle *Pyrrhalta luteola*	Elm	Rutland Lamoille County	Shade tree. Moderate defoliation of small trees.
Elm Leaf Miner *Fenusa ulmi*	Elm	Rutland	Shade tree.
Elm Sawfly *Cimbex americana*			Not observed.
Euonymus Caterpillar *Yponomeuta sp.*			Not observed.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
European Snout Beetle *Phyllobius oblongus*	Sugar Maple Black Walnut	Waterbury Essex	 On provenance study trees at state nursery.
Fall Cankerworm *Alsophila pometaria*	Hardwoods	Sudbury	Around swamp area.
Fall Webworm *Hyphantrea cunea*	Cherry Apple Other spp.	Widely scattered	Continues to be very heavy in Windham County on roadside and hedgerow trees.
Flat Leaf Tiers *Psilocorcis sp.*			Not observed.
Forest Tent Caterpillar *Malacosoma disstria*			See narrative.
Green Striped Mapleworm *Anisota rubicunda*			Not observed.
Gypsy Moth *Lymantria dispar*			See narrative.
Half Winged Geometer *Phigalia titea*			Not observed.
Imported Willow Leaf Beetle *Plagiodera versicolora*	Willows Poplar	Starksboro	
Japanese Beetle *Popillia japonica*	Ornamentals	Widespread	More numerous than in 1992. Heavy populations in North-Central VT and Rutland County.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Large Aspen Tortrix *Choristoneura conflictana*			Not observed.
Leaf Beetle *Paria sp.* near *quadriguttata*	Black Walnut	Essex Jct.	On black walnut in provenance study at Essex nursery.
Linden Looper *Erranis tiliaria*			Not observed.
Locust Leaf Miner *Odontata dorsalis*	Black Locust	Chittenden Windham Lamoille Washington Orange Counties	Heavy damage mapped in Chittenden (14 acres) and Windham (24 acres) counties. Light elsewhere.
Maple-basswood Leaf Roller *Sparganothis pettitana*	Sugar Maple	Lamoille County	Very light.
Maple Leaf Cutter *Paraclemensia acerifoliella*			See narrative.
Maple Leafblotch Miner *Cameraria aceriella*			Not observed.
Maple Trumpet Skeletonizer *Epinotia aceriella*	Sugar Maple	Scattered throughout	Rarely observed, population continues to decline.
Maple Webworm *Tetralopha asperatella*	Sugar Maple	Franklin Lamoille Rutland Counties	Increasing. Mostly very light except for a Swanton sugarbush with 20% defoliation.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Mountain Ash Sawfly *Pristiophora geniculata*	Mountain Ash	Lamoille Washington Orange Counties	Populations low. Few seen.
Oak Leafróller *Archips semiferanus*			Not observed.
Oak-leaf Shot-hole *Japanagromyza viridule*	Red Oak	Barnet	
Oak Leaf Tier *Croesia semipurpurana*			See narrative.
Oak Skeletonizer *Bucculatrix ainsliella*			Not observed.
Orange-humped Mapleworm *Symmerista leucitys*	Sugar Maple	Southern Vermont	A few larvae observed.
Pear Sawfly (Slug) *Caliroa cerasi*	Cherry	Elmore Waterbury	
Pin Oak Sawfly *Caliroa sp.*			Not observed.
Red-humped Oakworm *Symmerista canicosta*	Cherry	Danville	Heavy on one bush.
Rose Chafer *Macrodactylus subspinosus*	Hardwood Ornamentals Roses Raspberries	Widespread	Heavy populations in North-Central Vermont.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Saddled Prominent *Heterocampa guttivata*			See narrative.
Satin Moth *Leucoma salicis*	Balsam Poplar Cottonwood	Throughout	Locally heavy in Chittenden & Rutland Counties, but not as widespread as in 1991-92. Mortality occurring from past defoliation in Royalton.
Solitary Oak Leaf Miner *Cameraria hamadryadella*			Not observed.
Spear-Marked Black Moth *Rheumaptera hastata*	Birch	Springfield	Moths occasionally observed.
Spiny Elm Caterpillar *Nymphalis antiopa*			Not observed.
Spring Cankerworm *Paleacrita vernata*			Not observed.
Uglynest Caterpillar *Archips cerasivoranus*	Cherry	Widely scattered	Remains common but light.
White Marked Tussock Moth *Orgyia leucostigma*			Not observed.
Willow Flea Beetle *Rhynchaenus rufipes*	Balsam Poplar	Reading	Heavy browning of foliage along streambank.

SOFTWOOD DEFOLIATORS

Arborvitae Leaf Miner, ***Argyresthia thuiella,*** **caused widespread browning of northern white cedar, some of it heavy enough to be detected during aerial surveys. A total of 219 acres were mapped in Addison (67 acres), Franklin (37 acres), Grand Isle (3 acres), and Washington (112 acres) Counties. All the damage was classified as moderate except for 23 acres of heavy defoliation in Addison County.**

Fall Hemlock Looper, ***Lambdina fiscellaria,*** **caused only light defoliation in widely scattered northern Vermont locations, although moths have been common statewide since 1991.**

Egg counts from branches collected in the winter had predicted light defoliation for all locations but one (Ferrisburg). In mid-June, larvae were sampled in 12 locations by beating branches of regeneration sized trees. The Ferrisburg location had the most larvae but defoliation was light.

The number of moths caught in the fall in pheromone traps in northern Vermont averaged less than half the number trapped in 1992. However, in southern Vermont, the numbers increased substantially. However, these counts were still lower than the catches from many northern Vermont sites in 1992 which subsequently received no defoliation (Table 10, Figure 6).

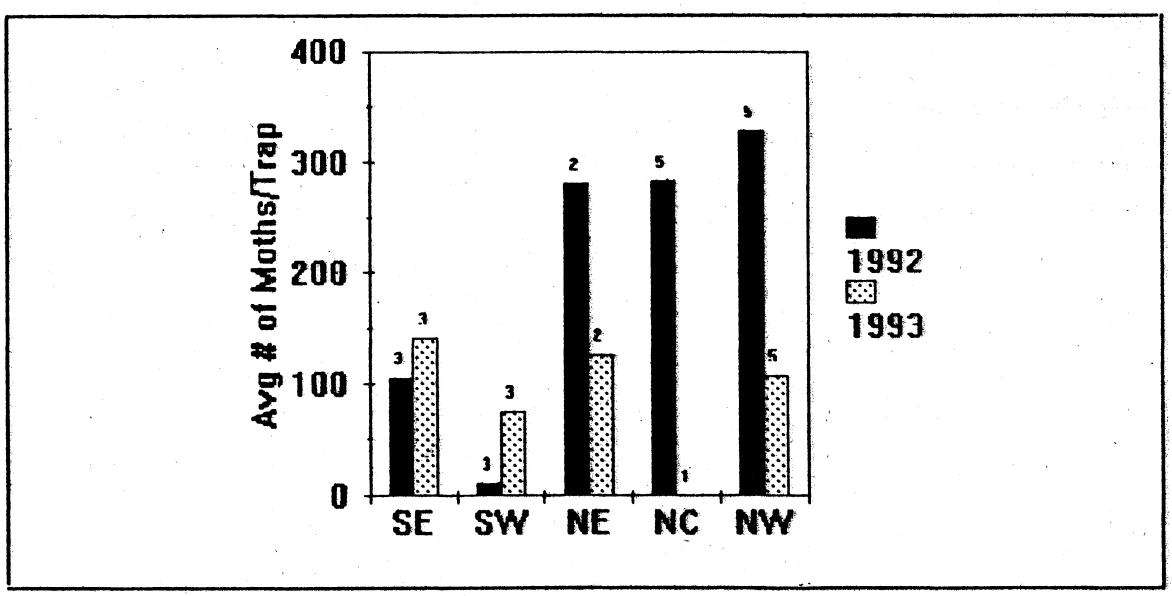


Figure 6. Average number of fall hemlock looper moths caught in pheromone traps, by year and region of the state[1].

[1] Average number in a single Multi-pher trap per site. Numbers above bars indicate number of sites per region.

Table 10. Fall hemlock looper counts in 1992-1993

Location		Viable Eggs/3m[1]		Larvae/3m[2]		Moths/Trap	
		Winter		Summer		Fall	
County	Town	91-92	92-93	1992	1993	1992	1993
Addison	Ferrisburg	0	5	0	17	38	86
Bennington	Dorset	3	0	0	-	15	126
Caledonia	Barnet	3	2	3	7	0	118
Caledonia	Sutton	-	-	-	1	-	-
Caledonia	Waterford	3	0	2	0	241	133
Chittenden	Bolton	0	0	0	1	714	288
Chittenden	Underhill-1	-	-	-	-	325	80
Chittenden	Underhill-2	-	-	-	-	521	27
Franklin	Swanton	2	4	0	2	-	55
Grand Isle	Alburg	0	0	0	0	-	-
Lamoille	Morristown-W	3	3	1	3	342	129
Lamoille	Morristown-N	0	4	0	1	261	112
Lamoille	Stowe	-	-	-	-	-	0
Orange	Strafford	1	0	0	0	454	117
Orange	Williamstown	3	3	0	0	316	160
Orleans	Derby	1	0	4	4	320	154
Rutland	Castleton	0	0	0	-	7	33
Rutland	Pittsford	1	1	0	-	10	67
Washington	Duxbury	-	-	-	-	666	250
Windham	Brattleboro	0	1	0	-	22	84
Windsor	Sharon	0	0	0	-	94	165
Windsor	Stockbridge	5	0	0	-	201	175
Average		**1.5**	**1.4**	**0.6**	**3.0**	**264**	**118**

[1] Number of eggs per three 1m long mid-crown branches (<4.5/3m=light defoliation).
[2] Number of larvae per 3m of foliage on understory trees (<30/3m=light population).
[3] Number of moths per Multipher trap baited with a fall hemlock looper pheromone. One trap per site.

Spring Hemlock Looper, *Lambdina athasaria*, defoliation was not observed in 1993. First and second instar larvae were easily found in one site in Vernon, but this area had only light defoliation. Moths were caught in pheromone traps in Windham County, but not in northern Vermont, indicating that a population is still present in the area with past damage (Table 11).

Table 11. Number of spring hemlock looper moths caught in traps baited with fall hemlock looper pheromone[1].

County	Town	1991 Defoliation	Moths/Trap	
			1992	1993
Chittenden	Underhill-1	None	0	0
Chittenden	Underhill-2	None	0	0
Lamoille	Stowe	None	0	0
Windham	Brattleboro	None	22	31
Windham	Dummerston	Moderate	89	2
Windham	Vernon	Heavy	173	11

[1] Average of three multipher traps in 1992 and one in 1993

Damage from the 1990 and 1991 defoliation in southeastern Windham County continues to be visible from the air, with 690 acres of dieback and mortality mapped this year (Figure 7). Dieback in mapped areas averaged 27%, when checked on the ground, with 16% of the overstory hemlocks dead.

Monitoring continues in plots established to determine the impact of defoliation in 1990-91, in cooperation with the U. S. Forest Service, and the states of Maine, New Hampshire, and Massachusetts. Additional mortality has occurred in some of the heavily defoliated stands, while dieback has increased in these as well as in the moderately defoliated stands (Figure 8).

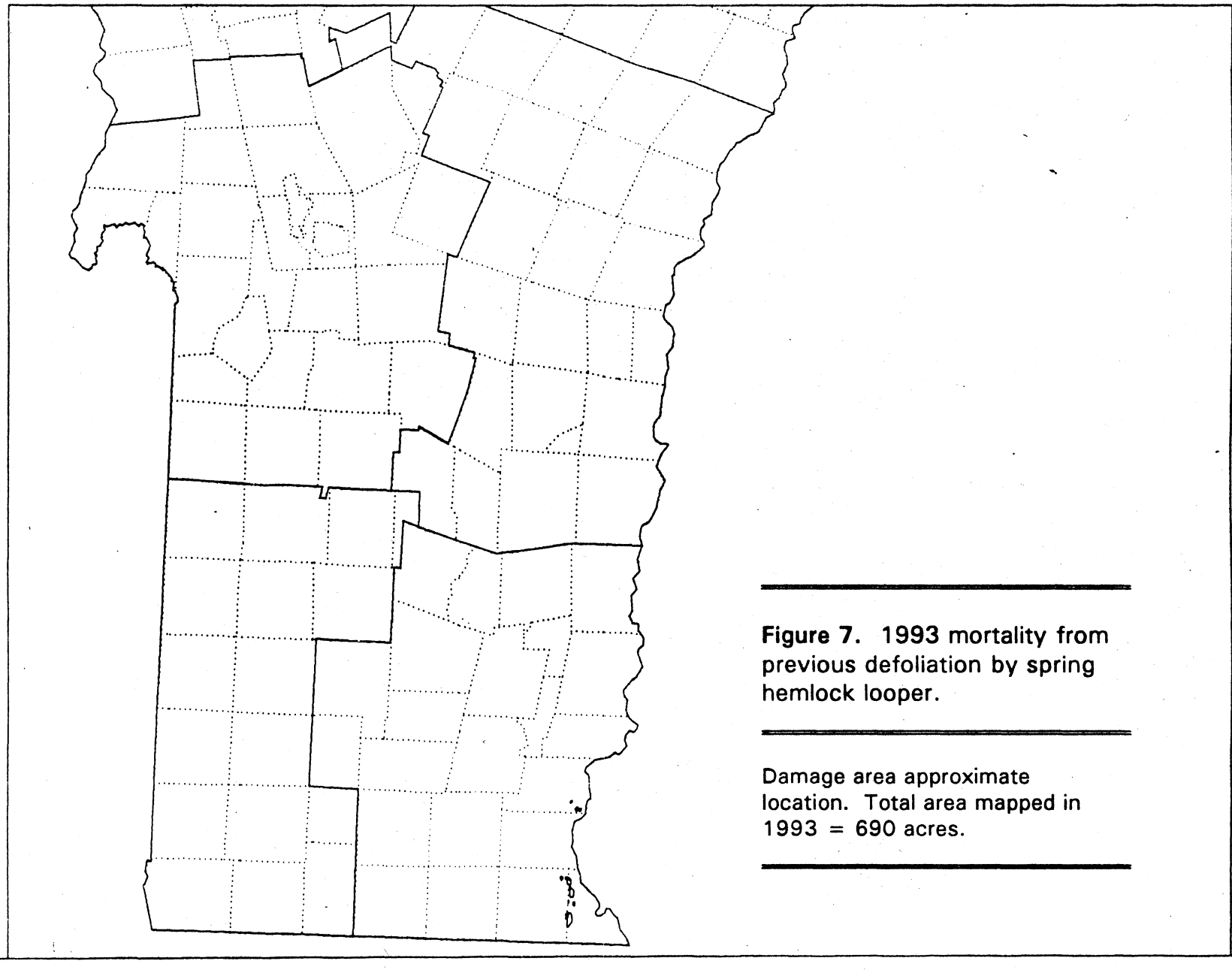


Figure 7. 1993 mortality from previous defoliation by spring hemlock looper.

Damage area approximate location. Total area mapped in 1993 = 690 acres.

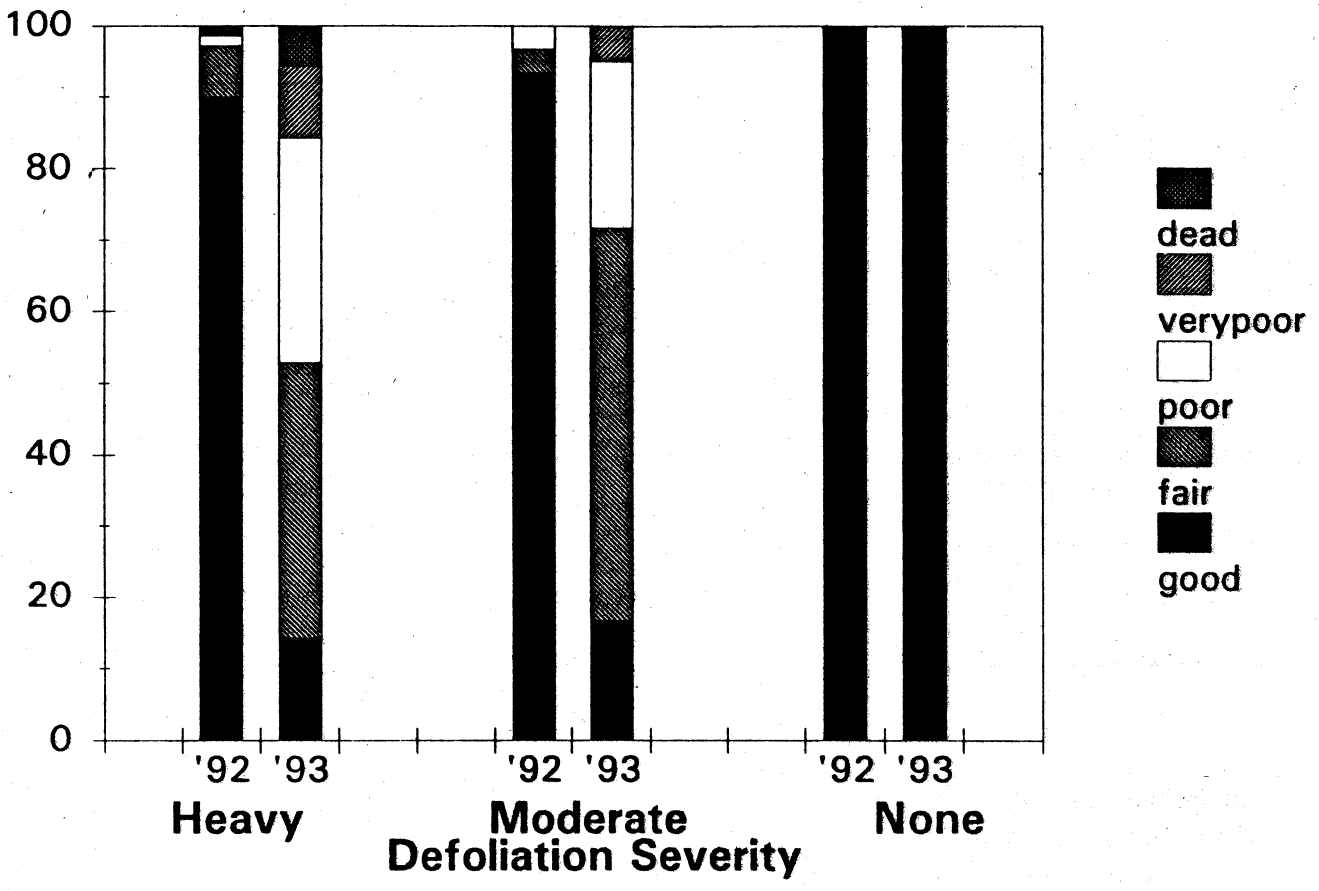
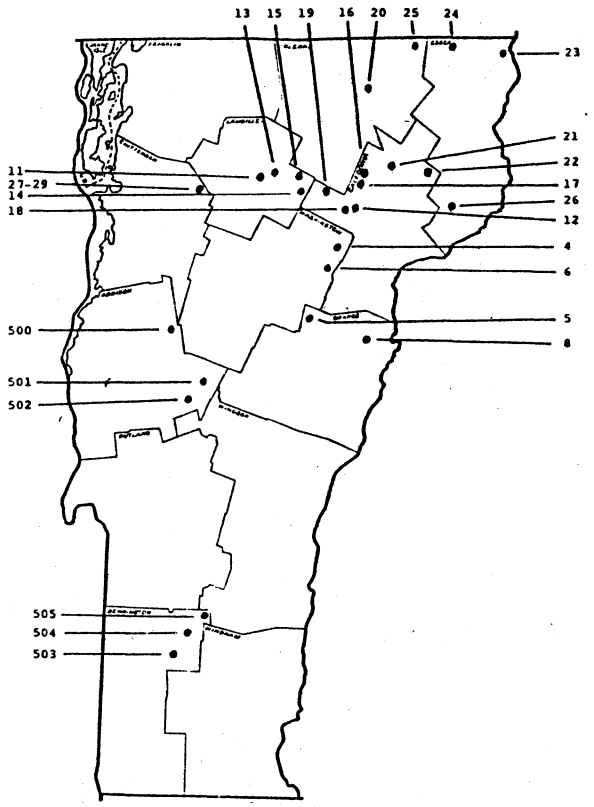


Figure 8. Percent of trees in spring hemlock looper impact plots in each of five condition classes when evaluated in spring of 1992 and 1993, by severity of 1991 defoliation.[1]

[1]Percent of ten trees in each of seven heavily defoliated stands, six moderately defoliated stands, and two non-defoliated stands.

Spruce Budworm, *Choristoneura fumiferana*, continued at low levels, with no visible defoliation detected. The number of moths captured in pheromone traps in northern Vermont, which showed a sudden increase in 1991, and continued at similar levels in 1992, dropped slightly in 1993 (Figures 9 and 10).



Location No.	Name	# of moths/trap
4.	Danville Hill	9.0
5.	Reservoir	9.0
6.	Marshfield Pd.	3.0
8.	Scotch Hollow	5.3
11.	Centerville	44.0
12.	Coles Pd.	2.3
13.	Diggins	23.0
14.	Wolcott F&G	7.0
15.	Bear Swamp	26.0
16.	Withers	14.3
17.	Mason	6.7
18.	Star School	13.0
19.	Beagle Club	12.3
20.	Brownington Pd.	7.3
21.	Calendar Brk.	20.0
22.	Chieppo	6.0
23.	Bunnel Brk.	0.7
24.	Norton Cem.	5.7
25.	Holland Pd.	2.3
26.	Victory Bog	9.0
27.	Underhill (VMC 1400)	16.0
28.	Underhill (VMC 2200)	6.3
29.	Underhill (VMC 3800)	1.7
	Average (excluding 28, 29)	10.9

Figure 9. Spruce budworm pheromone plot locations and average number of moths caught per trap in 1993.

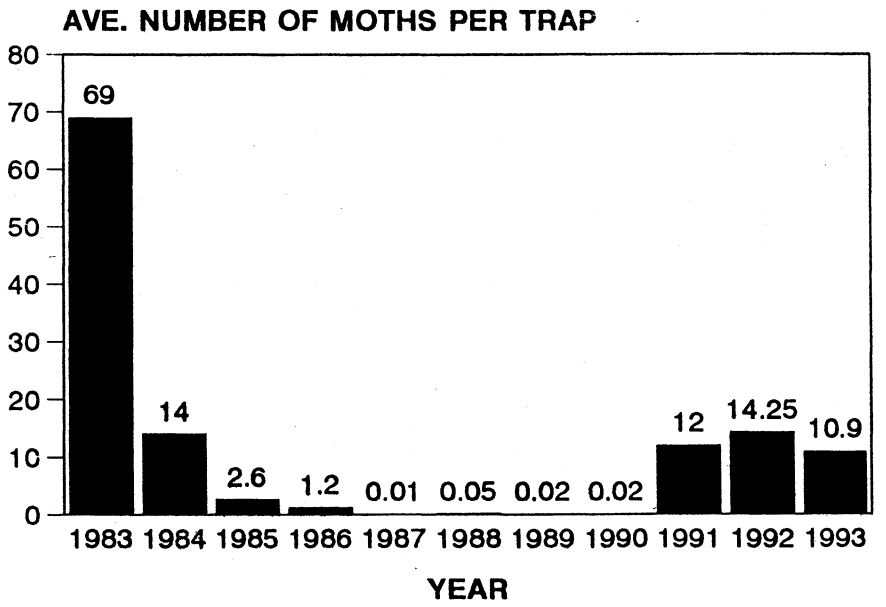


Figure 10. Average number of spruce budworm moths caught in pheromone traps, 1983 - 1993.

A special survey was conducted for large larvae in late June for the five locations with the highest moth catch in 1992. Ten 18" branches were collected per site, but no budworm larvae were found.

OTHER SOFTWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Arborvitae Leaf Miner *Argyresthia thuiella*			See narrative.
Balsam Fir Sawfly *Neodiprion abietis*			Not observed.
Dash-lined Looper *Protoboarmia porcelaria*			Not observed.
European Pine Sawfly *Neodiprion sertifer*	Scots pine	Chittenden Co.	Early instar larvae on Christmas trees indoors.
European Spruce Needleminer *Taniva albolineana*	Blue Spruce	Fair Haven	Ornamental.
Fall Hemlock Looper *Lambdina fiscellaria*			See narrative.
Green Hemlock Needleminer *Coleotechnites apicitripunctella*			Not observed.
Introduced Pine Sawfly *Diprion similis*	Scots Pine White Pine	Widely scattered	Observed in several Christmas tree plantations.
Japanese Beetle *Popillia japonica*	Balsam Fir	Cornwall	

OTHER SOFTWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Larch Casebearer *Coleophora laricella*	Tamarack	Chittenden, Rutland & Lamoille Counties	Generally light damage. Occasional heavy defoliation in northern Vermont with 5 acres detected from the air.
Larch Looper *Semiothisa sexmaculata*			Not observed.
Larch Sawfly *Pristophora erichsonii*	Tamarack	Hartland	Light damage.
Microbagworm *Psychidae*	White Pine	Barre	
Nursery Pine Sawfly *Diprion frutetorum*			Not observed.
Orange Spruce Needleminer *Pulicalvaria piceaella*			Not observed.
Pine False Webworm *Acantholyda erythrocephala*			Not observed.
Pine Webworm *Tetralopha robustella*			Not observed.
Red-Headed Pine Sawfly *Neodiprion lecontei*			Not observed.
Spring Hemlock Looper *Lambdina athasaria*			See narrative.

OTHER SOFTWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Spruce Bud Moth *Zeiraphera canadensis*	White Spruce	Widely scattered	Populations continue to be very light.
Spruce Budworm *Choristoneura fumiferana*			See narrative.
Tussock Moth *Orygia sp.*	Mugho Pine	Morristown	
Web-spinning Sawfly *Pamphiliidae*			Not observed.
White Pine Sawfly *Neodiprion pinetum*	White Pine	Putney Rutland	Moderate damage by first and second generations.
Yellow-headed Spruce Sawfly *Pikonema alaskensis*	White Spruce	Thetford Danville St. Johnsbury	Recent plantation. Ornamentals.

SAPSUCKING INSECTS, MIDGES, AND MITES

Balsam Gall Midge, *Paradiplosis tumifex*, populations remain low. During the annual northern Vermont Christmas tree survey, only one balsam fir plantation had noticeable needle gall damage, and it was light. No damage is expected in 1994.

Balsam Twig Aphid, *Mindarus abietinus*, damage occurred throughout the state. In northern Vermont, damage was detected on 283 acres but most of this was light, compared to mostly moderate damage in 1992. Populations appeared to be heavier in southern Vermont where scattered heavy damage was observed. This generally occurred where spraying was not done, or was done too late.

Populations of the insect appeared to be crashing by mid-summer, as it was difficult to find aphids within damaged foliage. Overwintering eggs are also scarce in most plantations sampled, although they were easy to find in a couple of southern Vermont locations. Damage should be much reduced in 1993, but it is recommended that growers who had damage in 1993 take samples for egg counts in order to determine whether control is necessary in 1994.

Hemlock Woolly Adelgid, *Adelges tsugae*, was not observed. Monitoring continued at the site in Stockbridge where the insect was introduced, and no adelgids have been found. No adelgids have been found there since fall 1991, although 5 surveys have been done since then. No seedlings were found during a survey in May. In October, five seedlings were found, apparently wildlings. These were examined at 40x in the laboratory, and no signs of adelgids or insect feeding were observed. No signs of adelgid were observed on the hemlock seedlings which had been planted at the site in 1992 as trap trees.

Oystershell Scale, *Lepidosaphes ulmi*, was less evident this year. Thin crowns associated with this insect were observed in Dover at 2600' elevation. Old damage to beech trees in northern Vermont from infestations in the late 80's remains visible, but only light infestations of the insect were observed in 1993. In our survey plot in Huntington, the number of scales decreased to the lowest level seen in the past four years (Table 12, Figure 11).

Table 12. Number of oystershell scales on current year beech twigs in Camel's Hump State Forest, 1990-1993.[1]

	Average Number of Mature Viable Scales per:							
	Twig				Millimeter			
	1990	1991	1992	1993	1990	1991	1992	1993
Suppressed	2.1	0.9	2.6	1.2	0.05	0.04	0.19	0.04
Intermediate	8.5	5.9	6.8	1.4	0.13	0.14	0.09	0.04
Codominant	7.4	10.7	4.8	4.8	0.11	0.32	0.33	0.10

[1]Average for 10 branches from one tree per crown class, collected in autumn, each year.

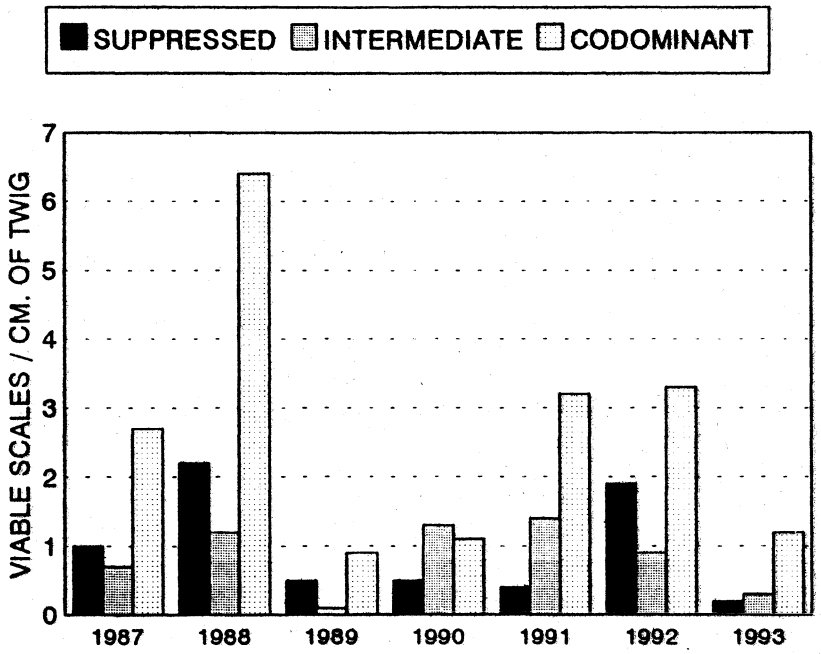


Figure 11. Oystershell scale populations in three tree canopy in Camel's Hump State Forest, 1987-1993. Average for 10 current year twigs/tree per crown class, collected in autumn.

Pear Thrips, ***Taeniothrips inconsequens***, caused heavy damage to sugar maple in northern Vermont this year, with nearly 84,000 acres mapped (Table 13, Figure 12). Damage during the past two years had not been heavy enough to detect by aerial survey. Lamoille County had the most damage, with nearly 45,000 acres followed by Orleans County with 17,500 acres, and Washington County with 12,100 acres. Pear thrips adults shaken from hobblebush flower heads in a Hyde Park maple stand prior to maple bud break were 25 times more abundant than in 1991.

The heaviest damage this year occurred in counties where numbers of thrips in the soil, in fall 1992, were the highest. Heavy flowering and dry spring conditions in 1992 had favored thrips survival.

Table 13. Mapped acres of damage by pear thrips in 1993.

County	Damage Severity		
	Moderate	Heavy	Total
Addison	370	0	370
Caledonia	1380	70	1450
Chittenden	1190	950	2140
Franklin	3390	1510	4900
Grand Isle	10	0	10
Lamoille	27040	17930	44970
Orange	400	0	400
Orleans	13530	4030	17560
Washington	6370	5770	12140
Total	**53680**	**30260**	**83940**

Upper elevation maples received the heaviest damage. Warm weather in early spring resulted in rapid leaf flush on low-elevation trees. Those at upper elevations were just breaking bud when the cool weather returned. Heaviest damage occurs when the thrips are able to feed within the leaf buds.

Many trees had severe damage, with such small leaves (approximately dime size), that they dropped those leaves and put out new ones. The refoliation was rapid due to ample precipitation in June. This indicates that trees were not as heavily stressed as thrips in 1988, when a severe June drought delayed refoliation. Most moderately damaged trees (30-60% defoliated) retained the stunted, mottled leaves for the remainder of the growing season.

In southern Vermont, pear thrips caused only light damage to overstory trees. Damage was generally heavier on regeneration. In Windsor County, bruce spanworm damage could frequently be seen in the overstory, and pear thrips damage in the understory. Scattered thin crowns on black cherry may have been caused by thrips defoliation.

Counts of adult thrips in developing buds were made again in southern Vermont in the spring. Numbers were comparable to counts in 1987 and 1990, when 22,000 acres and 3,400 acres of damage, respectively, were mapped in the region (Figure 13). The rapid flush of maple leaves in 1993, brought on by warm weather in late April and early May, is thought to be responsible for preventing more severe damage.

Researchers at the University of Vermont have been working with several fungi which kill pear thrips and are harmless to humans and trees. These were field tested this spring in three sugarbushes in central Vermont. The wettable powder formulation of *Verticillium lecanii*, the fungus commonly associated with diseased pear thrips in the soil, was the most effective. It will be further evaluated in 1994.

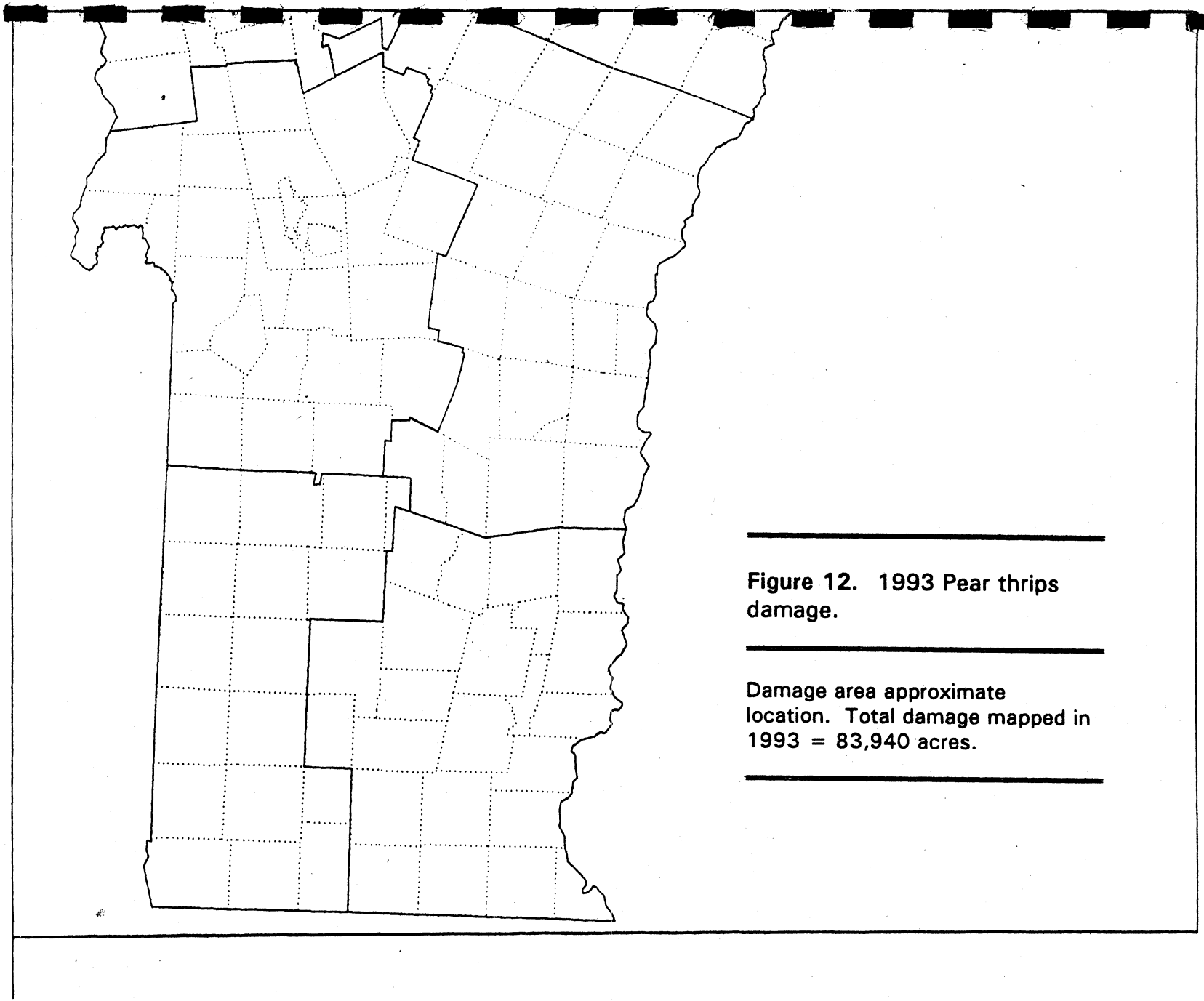


Figure 12. 1993 Pear thrips damage.

Damage area approximate location. Total damage mapped in 1993 = 83,940 acres.

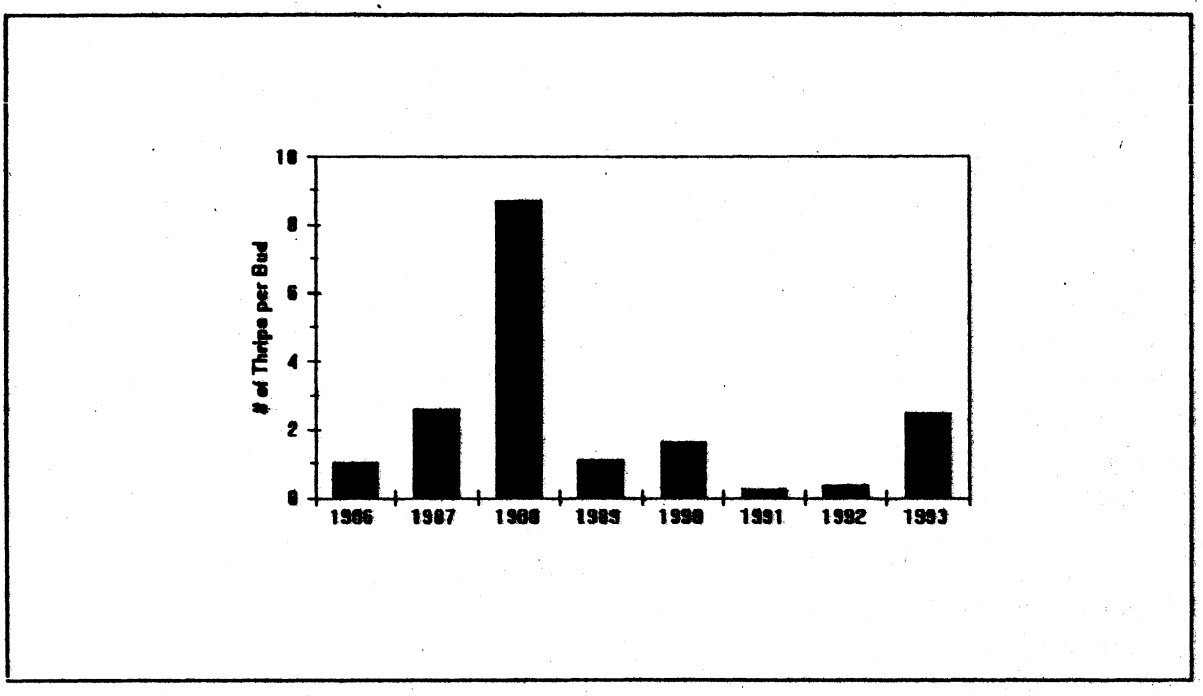


Figure 13. Average thrips counts in buds of sugar maple in southern Vermont 1986-1993. Average of 2 sugarbushes in 1986 and 6 sugarbushes in 1987-1993 (100 buds/sugarbush).

The impact of pear thrips damage on sugar maple physiology is being studied by researchers at the University of Vermont and the U.S. Forest Service. An experimental introduction of pear thrips onto juvenile trees of sugar maple reduced leaf area by approximately 20%. Pear thrips feeding damage caused a consistent reduction in leaf photosynthetic rates by 4 to 20%. Pear thrips feeding damage also reduced stomatal conductance to water vapor. There were no effects of pear thrips feeding damage on leaf water use efficiency or leaf conductances to water vapor in the dark.

Soil surveys were repeated in the fall, and overwintering thrips counts have been made at the University of Vermont. Counts were made by forcing insect emergence rather than extraction from the soil, as in prevoius years, and numbers were expected to be generally lower. However, extremely low counts statewide indicate that damage will be lower in 1994 (Figure 14). Wet weather when larvae were returning to the soil in June may have encouraged disease among the insects and reduced their numbers.

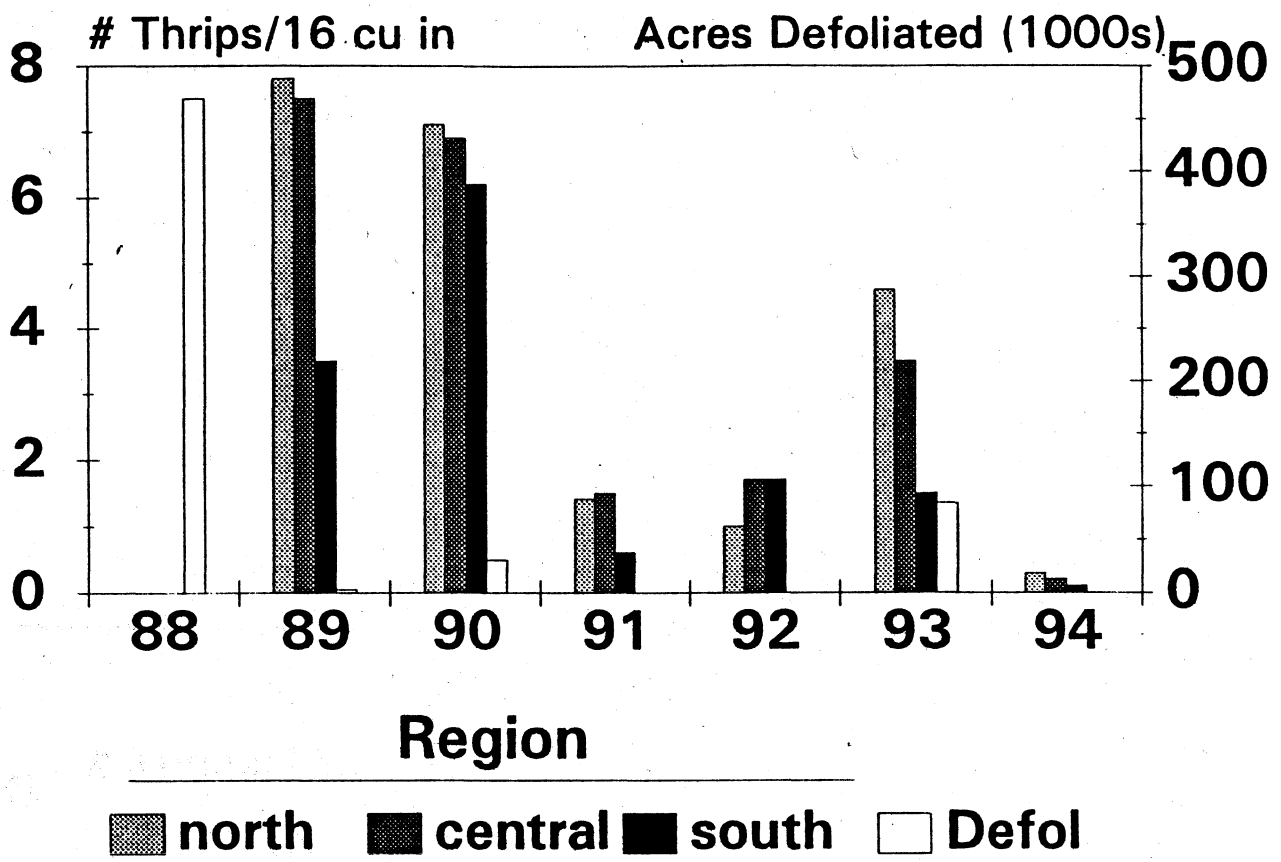


Figure 14. Average counts of overwintering pear thrips in soil samples (# of insects/16 in^3), by region of the state, compared to acres of thrips damage mapped statewide the following summer. Overwintering thrips numbers determined by extraction in 1989-93 and by forced emergence in 1994.

Pine Needle Midge, ***Contarinea baeri*****,** showed a marked increase this year, with 266 acres of damage to Scots pine Christmas trees reported for northern Vermont. Look for needles that bend downward from the fascicle and then droop, with damage noticeable at the tops of trees.

Spruce Spider Mite, ***Oligonychus ununguis*****,** continued to cause damage to scattered spruce and fir Christmas tree plantations and ornamentals. In southern Vermont, damaging populations built up rapidly early in the season causing occasional heavy damage, often collapsing during the hot mid-summer, and reappearing in late summer. In northern Vermont, most damage was light, but populations appeared to be increasing in balsam and fraser fir plantations by late summer. Overwintering eggs appear to be plentiful in widespread locations. Christmas tree growers should inspect their trees in spring 1994, for the presence of tiny reddish mites.

OTHER SAPSUCKING INSECTS, MIDGES AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Alder Spittlebug *Clastoptera obtusa*			Not observed.
Aphids *Cinara sp.*	White Spruce White Pine	Fletcher Concord Rockingham	On young Christmas trees. Fewer observations than in past years.
Aphids *Periphyllus sp.*	Sugar Maple	Danby	Sugarbush.
Arborvitae Aphid *Cinara tujafilina*			Not observed.
Balsam Gall Midge *Paradiplosis tumifex*			See narrative.
Balsam Twig Aphid *Mindarus abietinus*			See narrative.
Balsam Woolly Adelgid *Adelges picea*	Balsam Fir	Rutland & Windsor Counties Groton	Mostly light populations. Moderate damage in Sherburne. Evident in Groton for the first time since 1989.
Beech Scale *Cryptococcus fagisuga*			See Beech Bark Disease.
Birch Budgall Mite *Aceria rudis*	Paper Birch	Weston	Ornamentals.
Black Pineleaf Scale *Nuculaspis californica*	Red Pine	Charlotte	

OTHER SAPSUCKING INSECTS, MIDGES AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Catkin Bug *Kleidocerys sp.*			Not observed.
Cooley Spruce Gall Adelgid *Adelges cooleyi*	Douglas Fir Blue Spruce White Spruce	Widespread	Increasing on Douglas fir. 160 acres of damage reported in northern Vermont Christmas tree survey. Nearly half of this was heavy. Galls on spruce less commonly observed this year.
Cottony Maple Scale *Pulvinaria innumerabilis*	Sugar Maple	Lamoille Washington Orange Counties	Very light.
Eastern Spruce Gall Aphid *Adelges abietis*	White, Red & Norway Spruce	Throughout	Increasing in northern Vermont with 160 acres in northern Vermont Christmas tree survey compared to 34 acres in 1992. Elsewhere, stable.
Erineum Gall *Eriophyidae*	Beech Red Maple Sugar Maple Linden	Widespread	Unusually heavy throughout southern Vermont.
Eriophyid Mite Probably *Setoptus sp.*	White Pine	Grafton Springfield	Causing stunting and twisting of needles.
European Elm Scale *Gossyparia spuria*			Not observed.
Fletcher Scale *Lecanium fletcheri*			Not observed.

OTHER SAPSUCKING INSECTS, MIDGES AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Gouty Vein Midge *Dasineura communis*	Sugar Maple	Brattleboro Castleton Lamoille County	Ornamentals.
Hemlock Woolly Adelgid *Adelges tsugae*			See narrative.
Lacebugs *Corythuca sp.*	American Elm Balsam Poplar	Lamoille County	Scattered moderate-heavy damage.
Leafhoppers *Cicadellidae*			Not observed.
Lecanium Scale *Lecanium sp.*			Not observed.
Lupine Aphid *Macrosiphum albifrons*	Lupine	Lincoln	
Maple Bladdergall Mites *Vasates quadripedes*	Sugar Maple	Bradford Hartland Morrisville	
Maple Spindle Gall Mites *Vasates aceris-crumena*	Sugar Maple	Widespread	Commonly observed. Similar to 1992.
Oak Gall *Macrodiplosis erubescens*	Oak	Burlington	
Oak Wool Sower's Gall *Callirhytis seminator*	Oak	Essex Junction	
Oystershell Scale *Lepidosaphes ulmi*			See narrative.

OTHER SAPSUCKING INSECTS, MIDGES AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Pear Thrips *Taeniothrips inconsequens*			See narrative.
Pine Bark Adelgid *Pineus strobi*	White Pine Scots Pine	Scattered throughout	Light infestations on Christmas trees in scattered locations. Occasionally heavy on ornamentals. Generally less than previous years.
Pine Leaf Adelgid *Pineus pinifoliae*	White Pine	Throughout	Flagging shoots on white pine were common, sometimes in areas known to have had moderate to heavy populations of adelgids in 1992. No insects were detected this year.
Pine Needle Midge *Contarinea baeri*			See narrative.
Pine Needle Scale *Chionapsis pinifoliae*			Not observed.
Pine Spittlebug *Aphrophora parallela*	Conifers	Throughout	More common than in 1992. 99 acres of light damage to white and scots pine Christmas trees in northern VT survey. Occasionally heavy on ornamentals.
Pine Thrips *Gnophothrips sp.*			Not observed.

OTHER SAPSUCKING INSECTS, MIDGES AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Pine Tortoise Scale *Toumeyella parvicornis*	Scots Pine	Barre	Associated with ladybird beetle larvae.
Ragged Spruce Gall Aphid *Pineus similis*	Red Spruce		Remains common in northern Vermont.
Root Aphid *Prociphilus americanus*			Not observed.
Smooth Vein Pocket *Macrodiplosis goruca*	Pin Oak	White River Jct.	Ornamental.
Spruce Bud Scale *Physokermes piceae*			Not observed.
Spruce Spider Mite *Oligonychus ununguis*			See narrative.
Succulent Oak Gall *Dryocosmos quercuspalustris*	Red Oak	Colchester	
Treehoppers *Membracidae*	White Ash	Townshend	Damage observed.
Vagabond Aphid *Mordwilkoja vagabunda*			Not observed.
Vein Pocket Gall *Macrodiplosis erubescens*	Pin Oak	Hartford	Ornamental.

OTHER SAPSUCKING INSECTS, MIDGES AND MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Woolly Alder Aphid *Prociphilus tesselatus*	Alder Silver Maple Cutleaf Maple	Scattered throughout	Occasionally heavy.
Woolly Apple Aphid *Eriosoma lanigerum*			Not observed.
Woolly Elm Aphid *Eriosoma americana*			Not observed.
Woolly Fold Gall *Cecidomyia niveipila*	Oak	Burlington	
Woolly Pine Scale *Pseudophilippia quaintancii*			Not observed.

BUD, SHOOT & STEM INSECTS

The **Balsam Shootboring Sawfly, *Pleroneura brunneicornis***, caused light to moderate shoot tip mortality on 329 acres of balsam and fraser fir Christmas trees in the northern Vermont survey compared to 93 acres in 1992. Fraser fir received 129 acres of damage. All but 59 acres of the total damage reported was light. Damage is likely to increase in 1994.

OTHER BUD, SHOOT & STEM INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Allegheny Mound Ants *Formica exsectoides*	Christmas trees	Fair Haven	Severe in one plantation.
Ambrosia Beetle *Scolytidae*	White Pine	Shrewsbury Mt. Holly	Forest trees.
Balsam Shootboring Sawfly *Pleroneura brunneicornis*			Not observed.
Black Vine Weevil *Otiorhynchus sulcatus*	Yew	Weston	Cause of wounds on shoots as well as foliar feeding.
Butternut Curculio *Conotrachelus juglandis*	Heartnut	Marlboro	Extensive boring on twigs.
Cambium Miner *Phytobia spp.*			Not observed.
Coneworm *Dioryctria spp.*			Not observed.
Linden Borer *Saperda vestita*			Not observed.
Locust Borer *Megacyllene robiniae*			Not observed.
Locust Twig Borer *Ecdytolopha insiticiana*			Not observed.

OTHER BUD, SHOOT & STEM INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Maple Petiole Borer *Caulocampus acericaulis*			Not observed.
Narrow-winged Tree Cricket *Oecanthus angustipennis*			Not observed.
Northeastern Sawyer *Monochamus notatus*	White Pine	Widely scattered	Several collected from Christmas trees.
Northern Pine Weevil *Pissodes approximatus*			Not observed.
Pales Weevil *Hylobius pales*	Scots Pine	Widely scattered	Christmas tree damage decreasing. Only occasional trees damaged.
Pine False Webworm *Acantholyda erythrocephala*			Not observed.
Pine Gall Weevil *Podapion gallicola*	Red Pine	Brownsville	Light damage.
Pine Root Collar Weevil *Hylobius radicis*	Scots Pine	Castleton	Christmas trees.
Pitch Nodule Maker *Petrova albicapitana*	Scots Pine	Ferrisburg	Associated with Zimmerman Pine Moth. Continuing to cause branch and tree mortality in a 41-acre plantation. Visible during aerial survey again this year.
Pitted Ambrosia Beetle *Corthylus punctatissimus*	Sugar Maple Seedlings	Orleans County	Light scattered damage in sugarbushes.
Pseudanthonomus validus			Not observed.

OTHER BUD, SHOOT & STEM INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Red Oak Borer *Monochamus sp.*	Red Oak	Sandbar	
Round-headed Apple Tree Borer *Saperda candida*	Apple Mountain Ash	Danville Wilmington	On stressed trees.
Saperda lateralis	Black Cherry	Springfield	Recently cut trees.
Sawyer *Monochamus sp.*	Balsam Fir	Stannard Brookfield	Moderate Christmas tree shoot mortality in a 20-acre plantation in Stannard; light damage to a 25-acre plantation in Brookfield. Recently cut conifer logs and slash were present in both plantations. This serves as breeding material for the insect.
Striped Ambrosia Beetle *Trypodendron lineatum*	Spruce logs	Moretown	Causing reduction in clapboard production at a local mill.
Sugar Maple Borer *Glycobius speciosus*	Sugar Maple	Widespread	Abundant damage in many stands, especially where sugar maples are the predominant species and/or are slow-growing.
Twig Pruner *Elaphiodionoides villosus*	Red Oak	Addison County Middlesex	Light damage. Down from 1992.
White Pine Weevil *Pissodes strobi*	Conifers	Throughout	Increased in northern VT Christmas tree survey. 510 acres damaged compared to 78 acres in 1992. Generally stable in southern Vermont.

OTHER BUD, SHOOT & STEM INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Zimmerman Pine Moth *Dioryctria zimmermanni*	Scots Pine	Ferrisburg	41-acre plantation aerially mapped again. See also pitch nodule maker.

ROOT INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Broad Necked Root Borer *Prionus laticollis*			Not observed.
Conifer Swift Moth *Korsheltellus gracilis*			Not observed.
June Beetle *Phyllophaga spp.*	Balsam Fir	Berkshire	White grubs destroying the root systems of one-year old balsam trees planted on former agriculture land without adequate weed control.
Strawberry Root Weevil *Otiorhynchus ovatus*	Rhododendron	N. Springfield	
Wireworm *Elateridae*			Not observed.

BARK INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Bark Beetle *Orthotomicus caelatus*	Scots Pine	Ferrisburg	
Bronze Birch Borer *Agrilus anxius*	Paper Birch	Scattered throughout Springfield	On declining trees. Recently planted ornamentals.
Eastern Ash Beetle *Hylesinus aculeatus*	Ash	Grafton	Still very common on firewood cut from a stand with heavy yellows.
Eastern Larch Beetle *Dendroctonus simplex*	Tamarack	Dover Orleans County	Associated with current mortality. Little activity except a few small pockets of decline.
Elm Bark Beetles *Hylurgopinus rufipes* *Scolytus multistriatus*			See Dutch Elm Disease.
Hemlock Borer *Melanophila fulvoguttata*	Hemlock	Windham County	Rarely associated with hemlock looper defoliated trees.
Ips avulsus			Not observed.
Lesser Peachtree Borer *Synanthedon pictipes*	European Plum	Rutland	Ornamentals.
Peach Bark Beetle *Phloeotribus dentifrons*			Not observed.
Pine Engraver *Ips pini*			Not observed.
Red Turpentine Beetle *Dendroctonus valens*			Not observed.

BARK INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Rustic Borer *Xylotechus colonus*			Not observed.
Tanbark Borer *Phymatodes testaceus*			Not observed.

FOREST DISEASES

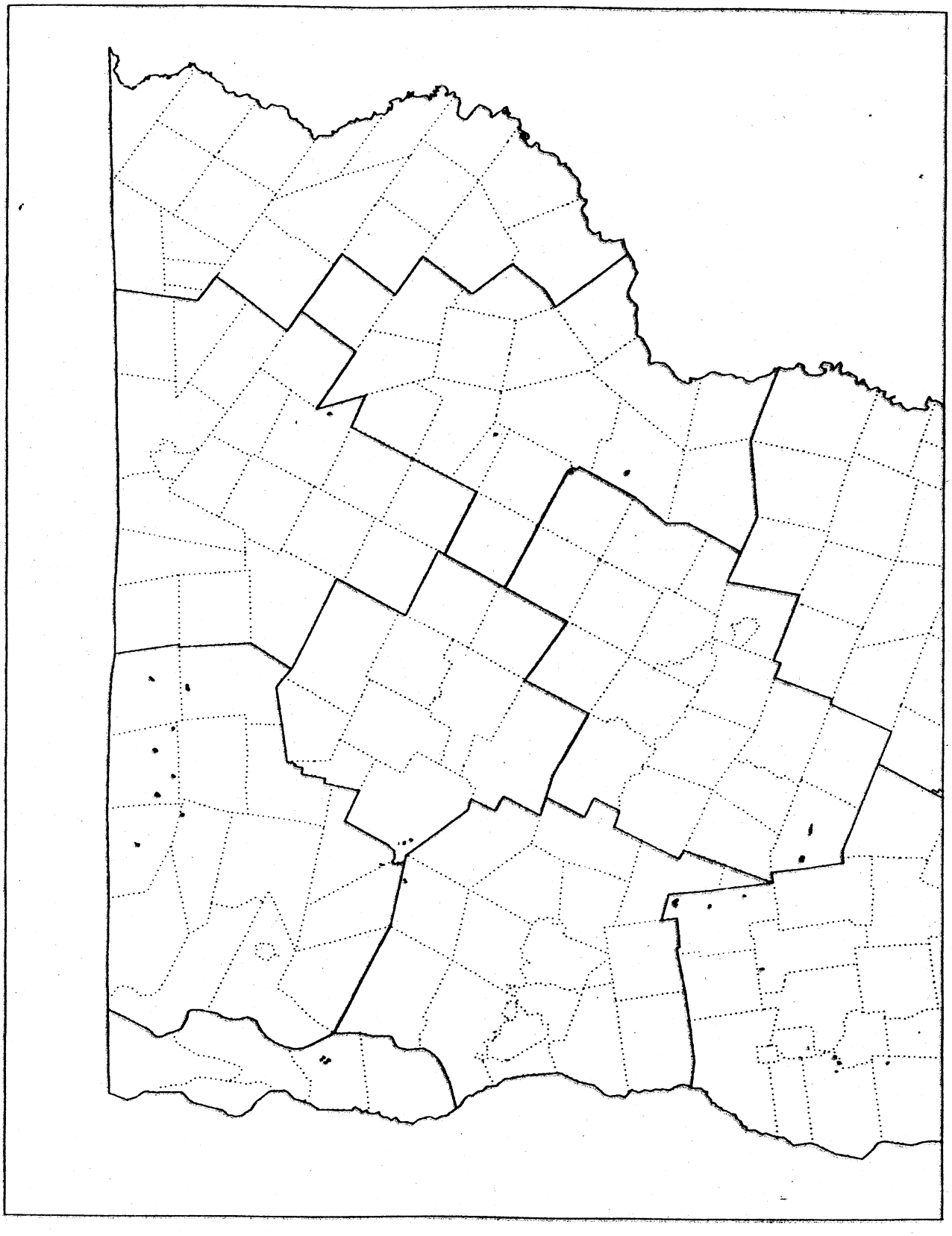
Stem Diseases

Beech Bark Disease, caused by *Cryptococcus fagisuga* and *Nectria coccinea* var. *faginata*, caused noticeable chlorosis to beech throughout the state with 3,290 acres of scattered damage mapped from the air (Table 14, Figure 15). Beech scale infestations were more noticeable in some locations than in 1992 when 1,960 acres were mapped. In one ground checked plot, 23% of the beech had dieback on >10% of the crown, and 15% were also chlorotic.

Table 14. Mapped acres of beech decline and mortality due to beech bark disease in 1993.

County	Acres
Addison	250
Caledonia	70
Chittenden	20
Franklin	270
Grand Isle	60
Lamoille	20
Orleans	20
Washington	80
Windham	1840
Windsor	660
Total	**3290**

The condition of trees is generally unchanged in southern Vermont monitoring plots. However, the levels of scale and Nectria have increased slightly in two out of three plots (Figure 16).



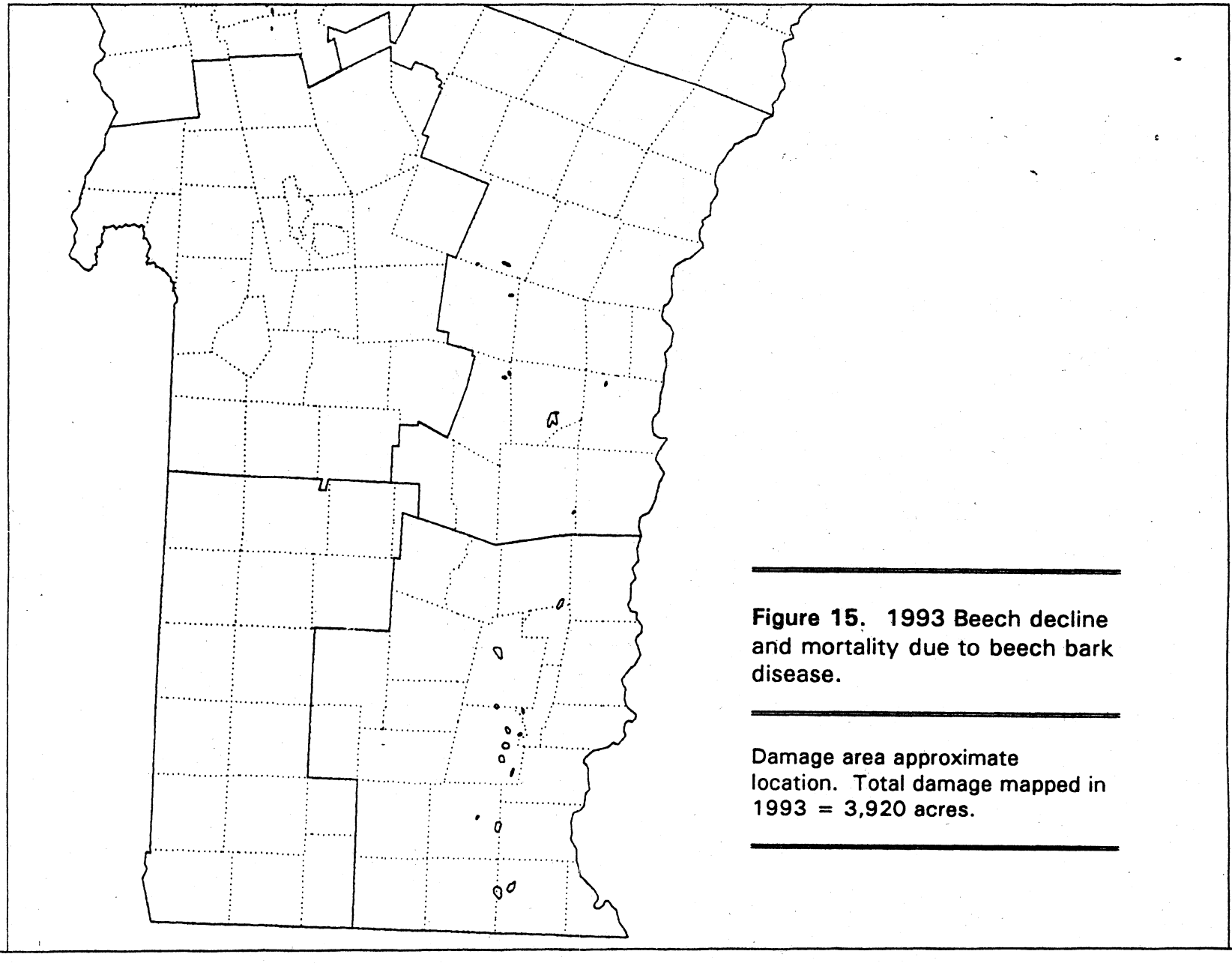


Figure 15. 1993 Beech decline and mortality due to beech bark disease.

Damage area approximate location. Total damage mapped in 1993 = 3,920 acres.

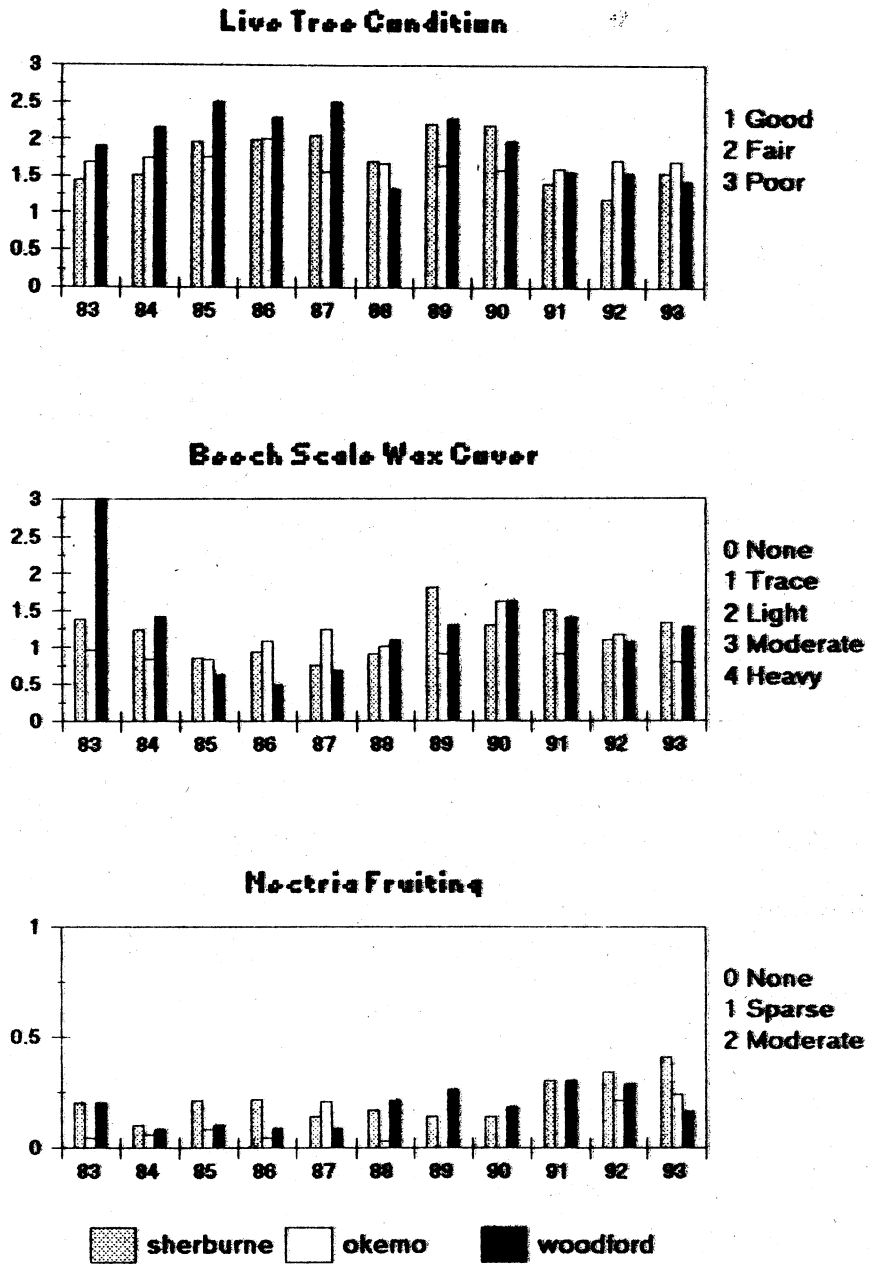


Figure 16. Average live tree condition, beech scale wax cover, and nectria fruiting ratings in three locations, 1983-1993.

New ground plots were also rated in three northern Vermont sites. Trees are currently in good condition in all plots.

A preliminary study to evaluate possible biocontrol activities of the entomopathogenic fungus, *Verticillium lecanii*, against beech scale has been initiated by the U.S. Forest Service and the University of Vermont.

Butternut Canker, caused by *Sirococcus clavigignenti-juglandacearum*, was confirmed as present throughout the state, causing widespread, and in some cases almost complete, mortality of butternut. Over 20 sites were surveyed, representing all counties, by sampling at least 6 twig samples with suspected canker. Presence of the fungus was determined by cultural identification, especially of conidia growing on the plates, by Dr. Dale Bergdahl at the University of Vermont. The disease was confirmed at all sites (Table 15). Where regeneration (<6' tall) was present near sample trees, most or all of the regeneration was cankered as well.

Table 15. Locations positive for Butternut Canker Fungus in 1993.

County	Town	# Trees Sampled
Addison	Addison	NA
Bennington	Dorset	1
Caledonia	Lyndon	2
Chittenden	Williston	NA
Essex	Concord	1
	Concord	2
Franklin	Bakersfield	6
	Georgia	2
Grand Isle	South Hero	3
Lamoille	Hyde Park	6
	Stowe	6
Orange	Bradford	5
	Fairlee	3
	Williamstown	4
Orleans	Albany	3
	Coventry	1
	Greensboro	2
Rutland	Clarendon	1
Washington	Berlin	5
Windham	Grafton	1
Windsor	Plymouth	1

Guidelines for harvesting butternut, developed by the U.S. Forest Service, have been adopted for state forest lands. Other forest landowners have been encouraged to consider these guidelines as well. The guidelines are intended to protect potentially resistant individuals and to create stand conditions that will enable the establishment of natural regeneration.

Scleroderris Canker, caused by *Ascocalyx abietina*, was not found in any new towns for the seventh consecutive year. A total of 50 Christmas tree plantations within the quarantine zone (Figure 17), and 145 red and Scots pine plantations in 26 towns bordering the quarantine area, were surveyed for the presence of the disease, all with negative results. Symptomatic branches were found in a new town (Derby) but the disease could not be confirmed by spores or culturing. It will be resampled in 1994.

The total number of plantations in the state known to be infected is now 126, consisting of 107 red pine and 19 Scots pine plantations. This represents 845 and 152 acres respectively, for a total of 997 acres infected. Another six plantations were infected at one time, but have since had the disease eradicated or the trees cut. Some recent infection can be found within most of the quarantine zone but it is less noticeable than in the past.

Sirococcus Shoot Blight, caused by *Sirococcus conigenus*, was less noticeable in mature plantations in Peacham (Blake Hill) and another such plantation in Plainfield (Jones State Forest) than in 1992. Light shoot mortality was evident throughout the crowns of scattered individual trees in Blake Hill and up to mid-crown at Jones. Individual current-year infected shoots were counted on 10 tagged individual trees at Blake Hill by two observers using binoculars and then averaged. Counts were surprisingly close to one another. These trees will serve as the basis for future evaluations to determine disease trend.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Annual Canker *Fusarium sp.*	Sugar Maple	Reading Johnson Duxbury Montpelier	Observed on stressed, slow-growing trees.
Ascochyta Blight *Ascochyta syringae*			Not observed.
Ash Yellows *Mycoplasma-like organism*	Ash	Throughout	Continues to cause mortality, perhaps less than some years. See ash dieback.
		Westford	Two new confirmations in 1993.

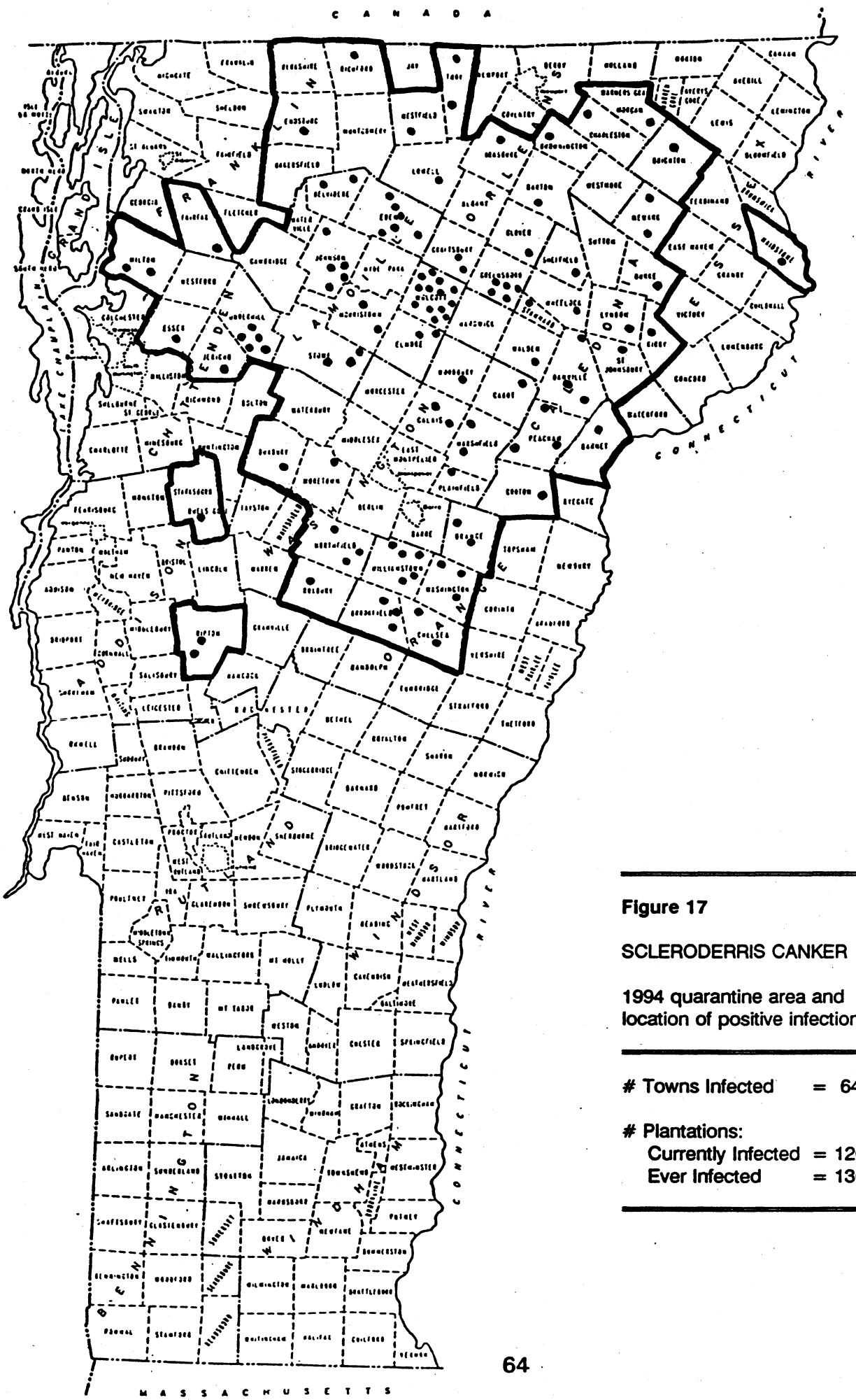


Figure 17

SCLERODERRIS CANKER

1994 quarantine area and location of positive infection

# Towns Infected	= 64
# Plantations:	
Currently Infected	= 126
Ever Infected	= 130

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Aureobasium sp.	Balsam Fir	Springfield	Causing branch mortality of drought stressed Christmas trees.
Balsam Fir Twig Abnormality *Sclerotinia kerneri*			Not observed.
Beech Bark Disease *Cryptococcus fagisuga* and *Nectria coccinea var. faginata*			See narrative.
Black Knot *Dibotryon morbosom*	Black Cherry	Throughout	Stable.
Botryosphaeria Canker *Botryosphaeria sp.*			Not observed.
Brown Rot *Monilinia fructicola*	Cherry	Hartland	Ornamental.
Butternut Canker *Sirococcus clavigignenta-juglandacearum*			See narrative.
Caliciopsis Canker *Caliciopsis pinea*	White Pine	Orange Washington Counties	Fewer symptoms noticed this year.
Chestnut Blight *Cryphonectria parasitica*	American Chestnut	Windham Chittenden & Addison Counties	Canker on a nut-bearing tree in Vernon.
Cytospora Canker *Leucostoma kunzei*	Blue Spruce	Widespread	Common on ornamentals.
Diplodia Shoot Blight *Diplodia pinea (Sphaeropsis pinea)*	Scots Pine	Fair Haven	Christmas trees.
	White Pine	Springfield	Ornamentals.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Dutch Elm Disease *Ceratocystis ulmi*	American Elm	Throughout	Mortality continuing at stable levels. 13 acres of mortality mapped in Addison County.
Eastern Dwarf Mistletoe *Arceuthobium pusillum*			Not observed.
Fir Broom Rust *Melampsorella caryophllacearum*	Balsam Fir Fraser Fir	Widespread	Found within 190 acres of fir plantations - Northern VT survey. Usually limited to a few trees per plantation.
Fireblight *Erwinia amylovora*	Apple	Rutland Caledonia & Orleans Counties	Ornamental.
Hypoxylon Canker *Hypoxylon pruinatum*	Aspen	Throughout	Remains common. Trees frequently break off at canker during heavy snow and ice storms.
Maple Canker *Steganosporium ovatum*			Not observed.
Oak Wilt *Ceratocystis fagacearum*			No Oak Wilt suspects observed by trained observers in aerial flights or ground checks.
Phomopsis Gall *Phomopsis sp.*	Bitternut Hickory	Rockingham Weathersfield	Ornamentals.
Phomopsis Twig Blight *Phomopsis sp.*	Dogwood Carpathian Walnut	Ripton Middlebury	Colonized winter-injured branches.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Red Rot	Balsam Fir	Shrewsbury	Cause of volume loss to timber sales.
	White Pine	Sharon	
		Springfield	Cause of seams.
Sapstreak *Ceratocystis coerulescens*		Washington Co. Orange Co.	Occasionally seen.
Scleroderris Canker *Asocalyx abietina*			See narrative.
Sirococcus Shoot Blight *Sirococcus strobilinus*			See narrative.
Smooth Patch *Dendrothele macrodens*	White Ash	Throughout	Particularly abundant in sites near water.
Tomentosus Butt Rot *Inonotus tomentosus*			See Root Disease.
Venturia Shoot Blight *Venturia tremulae*	Trembling Aspen	Norwich	Young trees.
Verticillium Wilt *Verticillium albo-atrum* or *V. dahliae*	Sugar Maple	Castleton Norwich Morristown Hyde Park Craftsbury	Ornamentals.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
White Pine Blister Rust *Cronartium ribicola*	White Pine	Throughout	Commonly observed. Incidence on Christmas trees increased. In northern VT survey, 424 acres infected compared to 62 acres in 1992. Damage was moderate on 125 acres and heavy on 55 acres.
Woodgate Gall Rust *Endocronartium harknessii*	Scots Pine	Throughout	Increasing. In northern VT survey, 23 acres of light-moderate damage compared to 82 acres in 1992.

Foliage Diseases

Dogwood Anthracnose, caused by *Discula destructiva*, was confirmed to be present in the only two counties where native flowering dogwood is known to occur. Diseased samples from one site per county (Brattleboro and Pownal) were collected. The presence of the fungus was confirmed by Dr. Dale Bergdahl at the University of Vermont. Samples had leaf spots and small elliptical twig cankers, characteristic of dogwood anthracnose. Both samples produced conidia of the fungus, in culture, on the surface of the leaf tissue.

None of the flowering dogwood trees at either site were healthy, with some mortality at the Brattleboro site. Dieback on sample trees ranged from 30-100%. All trees examined had symptoms on the twigs, branches, and epicormic shoots, as well as leaves, if present.

Maple Anthracnose, caused by *Gloeosporium sp.*, was mapped on 115 acres in Addison and Franklin Counties. Damage occurred in small spots. Light and moderate damage to red and sugar maples occurred elsewhere in scattered locations throughout the state.

OTHER FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Anthracnose *Gloeosporium spp.* *Apiognomonia sp.*	Red Oak Apple Carpathian Walnut	Scattered throughout	See also Maple Anthracnose and Sycamore Anthracnose.
Apple Scab *Venturia inequalis*	Apple	Widespread	Heavy infection in north-central mountains and Northeast Kingdom.
Basswood Leaf Blotch *Asteroma tiliae*	Basswood	Reading	Moderate-heavy browning along streambank.
Cedar-Apple Rust *Gymnosporangium juniperi-virginianae*			Not observed.
Coccomyces Leaf Spot *Blumeriella jaapii*	Black Cherry	Stowe Peacham	Moderate leaf damage to scattered trees.
Cyclaneusma Needlecast (formerly Naemacylcus) *Cyclaneusma minus*	Scots Pine	Widespread	Moderate leaf damage to scattered trees.

OTHER FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Dogwood Anthracnose *Discula destructiva*			See narrative.
European Larch Needlecast *Mycosphaerella laricina*			Not observed.
Fir-Fern Rust *Uredinopsis mirabilis*	Balsam Fir	Throughout	Increasing. In Northern VT survey, 121 acres reported lightly infested compared to 56 acres in 1991.
Giant Tar Spot *Rhytisma sp.*	Norway Maple	Bennington	Spots on nearly every leaf of an ornamental.
Hemlock Needlecast Cause unknown	Hemlock	Jamaica Woodstock Pomfret	Premature yellowing and casting of shaded foliage was common, and is thought to be linked to a fungus, although none has been identified.
Lophodermium Needlecast *Lophodermium seditiosum*	Scots Pine	Widespread	Increasing. 345 acres (289-light) in northern VT survey compared to 38 acres in 1992.
Marssonina Leafspot *Marssonina brunnea*	Cottonwood	Rutland County	Mapped on 40 acres of bottomland forest.
	White Poplar	Brattleboro	Ornamental.
Oak Leaf Blister *Taphrina coerulescens*	Oak	Burlington	
Poplar Leaf Bronzing *Virus* or *virus-like casual agent*	Balsam Poplar	Caledonia Orleans Counties	Remains common.

OTHER FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Powdery Mildew *Eryiphaceae*	Lilac	Rutland	Ornamentals.
Rhabdocline Needlecast *Rhabdocline pseudotsugae*	Douglas Fir	Widespread	Increasing. Light to moderate needle loss on 104 acres.
Rhizosphaera Needlecast *Rhizosphaera kalkhoffi*	Blue Spruce White Spruce	Widespread	Damage to Christmas trees increased, with 226 acres damaged in northern VT survey. Damage was light on 142 acres, moderate on 80 acres and heavy on 4 acres. Mostly blue spruce (110 ac) affected. Also reported on ornamentals from Lincoln, Fair Haven and Brattleboro.
Septoninia Leafspot *Septoninia podophyllina*	Hybrid Poplar	Londonderry	Heavy defoliation of shade tree.
Swiss Needlecast *Phaeocryptopus gaumanni*	Douglas Fir	Widely scattered	Increasing. Moderate to heavy damage on 111 acres of Christmas trees in northern VT survey.
Sycamore Anthracnose *Gnomonia platani*	Sycamore	Throughout	Widespread defoliation due to low temperatures in late May. Resulted in late refoliation.
Tar Spot *Rhytisma acerinum*	Red Maple	Widespread	Not observed in 1992 but common this year. See Giant Tar Spot.
Tar Spot *Rhytisma punctatum*	Sugar Maple	Widespread	First time noticed since 1986. Consists of many small spots that don't coalesce.
Unknown Leafspot	Red Maple	Bennington	Localized heavy damage to several acres of trees near forest edge.

ROOT DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Annosus Root Rot *Heterobasidion annosum*			Not observed.
Cylindrocarpon Root Rot *Cylindrocarpon sp.*			Not observed.
Shoestring Root Rot *Armillaria spp.*	Sugar Maple	Newfane	Associated with death of lightning struck tree.
	Red Maple	Manchester	A half a dozen new trees have been killed in an enlarging infection center. Fungus has been cultured by Dr. Phil Wargo of the U.S. Forest Service and appears to be a normally non-aggressive species.
	Red Spruce	Green Mountain National Forest	Forest plan monitoring has shown a concern with prescribed burning and Armillaria. Retention of trees in cutting units may cause root rot in large trees.
	Balsam Fir	Wheelock	Killing Christmas trees in plantations where remains of old stumps are serving as infection courts for the fungus.
		Throughout	Common on stressed forest trees.
Tomentosus Root Rot *Polyporus tomentosus*	White Spruce	Dummerston	Fruiting in a young stand with mortality following recent thinning.

DIEBACKS, DECLINES, AND ENVIRONMENTAL DISEASES

Ash Dieback and thin crowns were unusually common in 1993. Leaves on ash throughout the state came out late, delayed by the cool spring weather. In Mendon, ash leaves were just starting to leaf out on June 20, and at 2000', they didn't have complete leaves until July.

Thin crowns were particularly common in the Champlain Valley and southern Vermont. When leaves did come out, many trees that had been healthy the previous year were thin. On affected trees, many shoots in the middle and lower crown did not produce foliage, leaving only a "green hat" of leaves in the uppermost crown. The buds at the end of the bare shoots were dead, and twigs died back. Some affected branches produced shoots from adventitious buds. The persistent petioles from the previous year's seeds were obvious on bare branches. In the fall, foliage of many affected ash turned brown instead of the usual purple.

Two widespread stress agents in 1992 could have been responsible for the symptoms. Heavy flower and seed production lowered energy reserves. In much of the state, there was also a late spring frost which killed emerging foliage and required the trees to refoliate. The dieback may be due to lower energy reserves, according to Dr. Bob Gregory, who examined affected branches at the U. S. Forest Service Aiken Lab. Inadequate reserves may have led to poor embryonic shoot formation inside newly developing buds or impaired bud survival during extremely low winter temperatures. In the absence of additional stress, most thin-crowned trees are expected to recover.

Ash dieback due to ash yellows was also common on trees of all sizes, particularly at low elevation sites, apparently at levels similar to previous years. Some trees had symptoms of both ash yellows and thin crowns attributed to seed production.

Symptomatic trees in Woodstock were marked to follow the health of thin ash trees. Dieback in trees with seed stalks attached averaged 21%, compared to 6% for otherwise healthy trees which had not produced seed in 1992. Eighty percent of those with dieback attributed to heavy seed production had produced a second flush of leaves. Monitoring plots were also established by the U.S. Forest Service.

Ash dieback was mapped on 150 acres during aerial surveys, with a substantial additional acreage mapped as hardwood decline, particularly in southern Vermont. Mapped as ash dieback were 70 acres in Addison, 20 in Chittenden, 30 in Franklin, 20 in Grand Isle, and 10 in Orleans Counties. Ash on three sites mapped as hardwood decline averaged 20% dieback.

Birch Decline and mortality was detected by aerial survey this year on 1,150 acres compared to 130 acres in 1992 (Table 16, Figure 18). Paper and yellow birch were affected, particularly paper birch. Washington County, with 670 acres, had the most damage. The dieback may be related to past defoliation and/or drought periods, and is more severe at higher elevations (See Birch Defoliators).

Table 16. Mapped acres of birch dieback and mortality in 1993.

County	Acres Mapped
Addison	160
Franklin	30
Lamoille	60
Orange	160
Rutland	30
Washington	670
Windham	40
Total	**1150**

Nine birch monitoring plots were established this year to follow the health of trees (over 5" dbh) defoliated by leaf miners and birch skeletonizer. These plots contain 296 paper birch and 87 yellow birch trees. Mortality (standing dead) on the plots averaged 6% for paper birch and 12% for yellow birch. Foliar transparency averaged 23% for paper birch and 16% for yellow birch. This is probably higher than normal for these species, as it compares with 16% and 11%, respectively for the 1991 statewide hardwood tree health survey. Percent of living birch trees healthy ranged from 42% to 100% per location and averaged 90% for both paper birch and yellow birch (Figure 19).

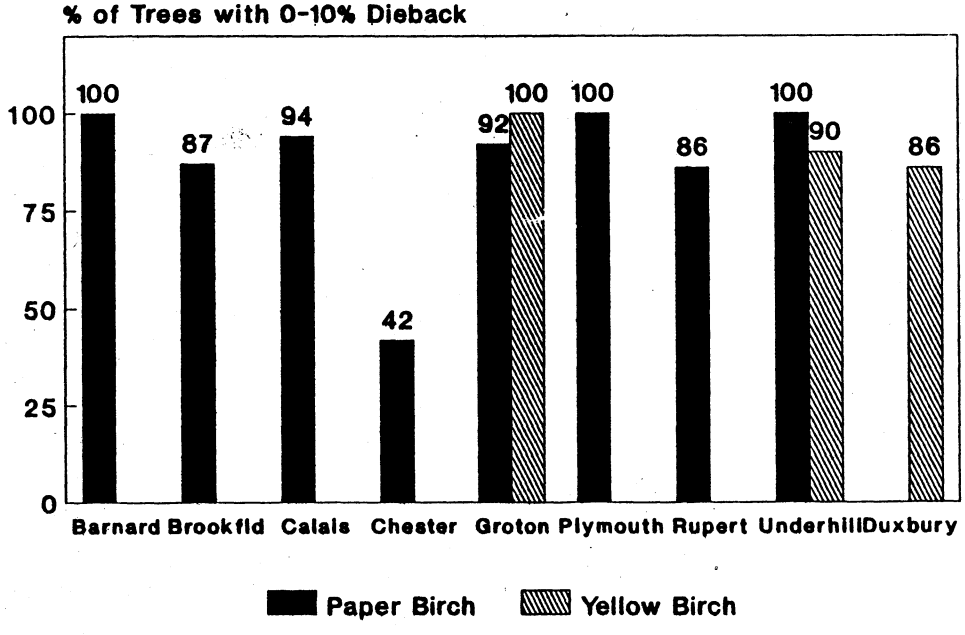
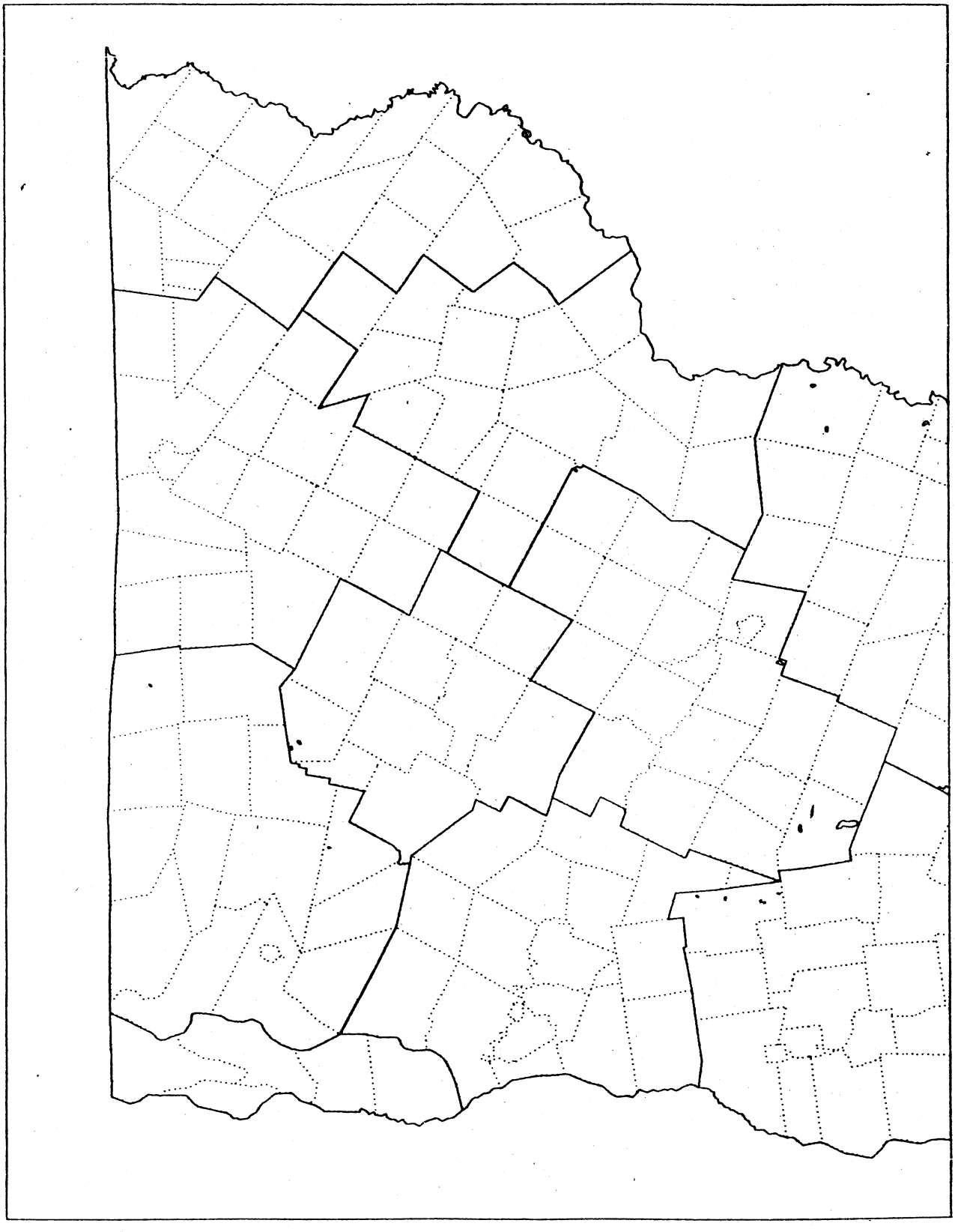


Figure 19. Percent of live birch trees (≥ 5" DBH) healthy in birch monitoring plots, by location, in 1993. Healthy trees have ≤ 10% dieback.



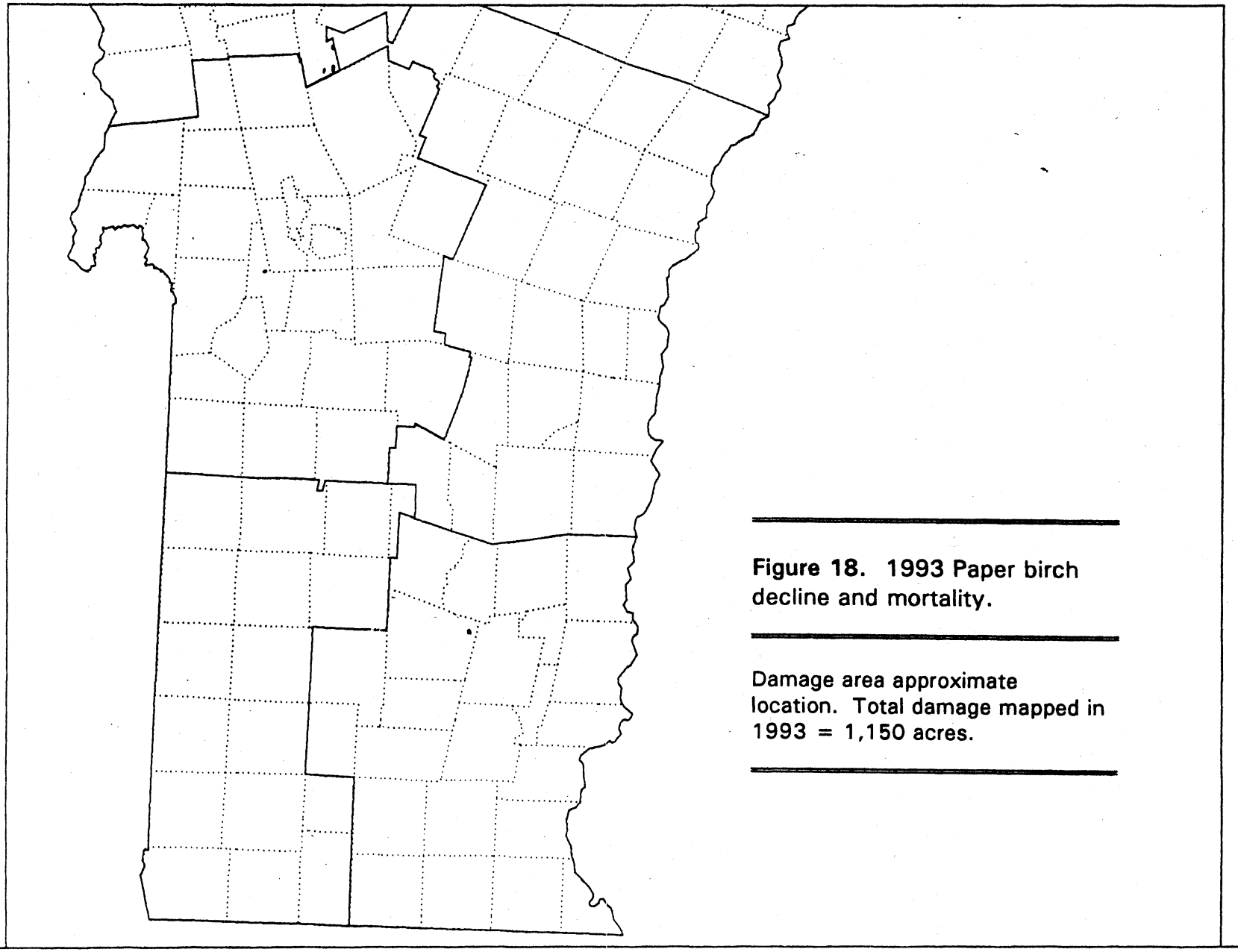


Figure 18. 1993 Paper birch decline and mortality.

Damage area approximate location. Total damage mapped in 1993 = 1,150 acres.

Drought Conditions in late spring and early to mid-summer led to a variety of tree health problems in southern Vermont. Some hardwood symptoms visible from the air, such as scorch and off-color foliage, were drought-related (See Hardwood Decline and Mortality).

Christmas tree planting failures were common, especially of trees which were planted too deep or on droughty sites. Cut Christmas trees from wet or ledgey sites were vulnerable to premature needle loss. In one plantation, drought is thought to be involved with the occurrence of a pocket of trees with dead branches infected with the weak pathogen, *Aureobasidium pullulans*. In another small, 2-year-old plantation of balsam fir, nearly all the trees died. Deep planting contributed to the drought stress.

Dry conditions also contributed to the occasional death of ornamental trees growing under suboptimal conditions such as near pavement, in compacted or gravelly soil, girdled by roots or barbed wire, or trees which were wounded.

In northern Vermont, problems continue from past drought, particularly with recent plantings.

Frost Damage was much reduced from recent previous years, and was mostly limited to Christmas tree plantations. Frost injury was reported on 452 acres, but most of this (407 acres) was light. Balsam fir was the species most affected, with 214 acres of visible damage, followed by white spruce with 72 acres.

A light frost on 5/23 caused scattered damage to beech in Bethel, Pittsfield, and Sherburne.

Hardwood Decline symptoms, such as thin crowns, off-color foliage, dieback, and mortality, were mapped on 80,930 acres (Table 17, Figure 20). This increase over the 23,480 acres mapped in 1992, is largely from the 50,980 acres mapped as having both pear thrips damage and scattered dieback, and may also reflect our continued effort to improve damage mapping. Much of the dieback was on sugar maple, but, in most cases, fewer than 30% of the canopy trees were affected.

Outside of the areas damaged by pear thrips, the symptoms were related to drought stress, beech bark disease, thin high elevation site, and thin ash.

Black Cherry crowns were unusually thin in scattered locations throughout the region, including Castleton, Rochester, and Windham. The cause is unknown but may have been caused by pear thrips feeding, which results in the shedding of immature leaves.

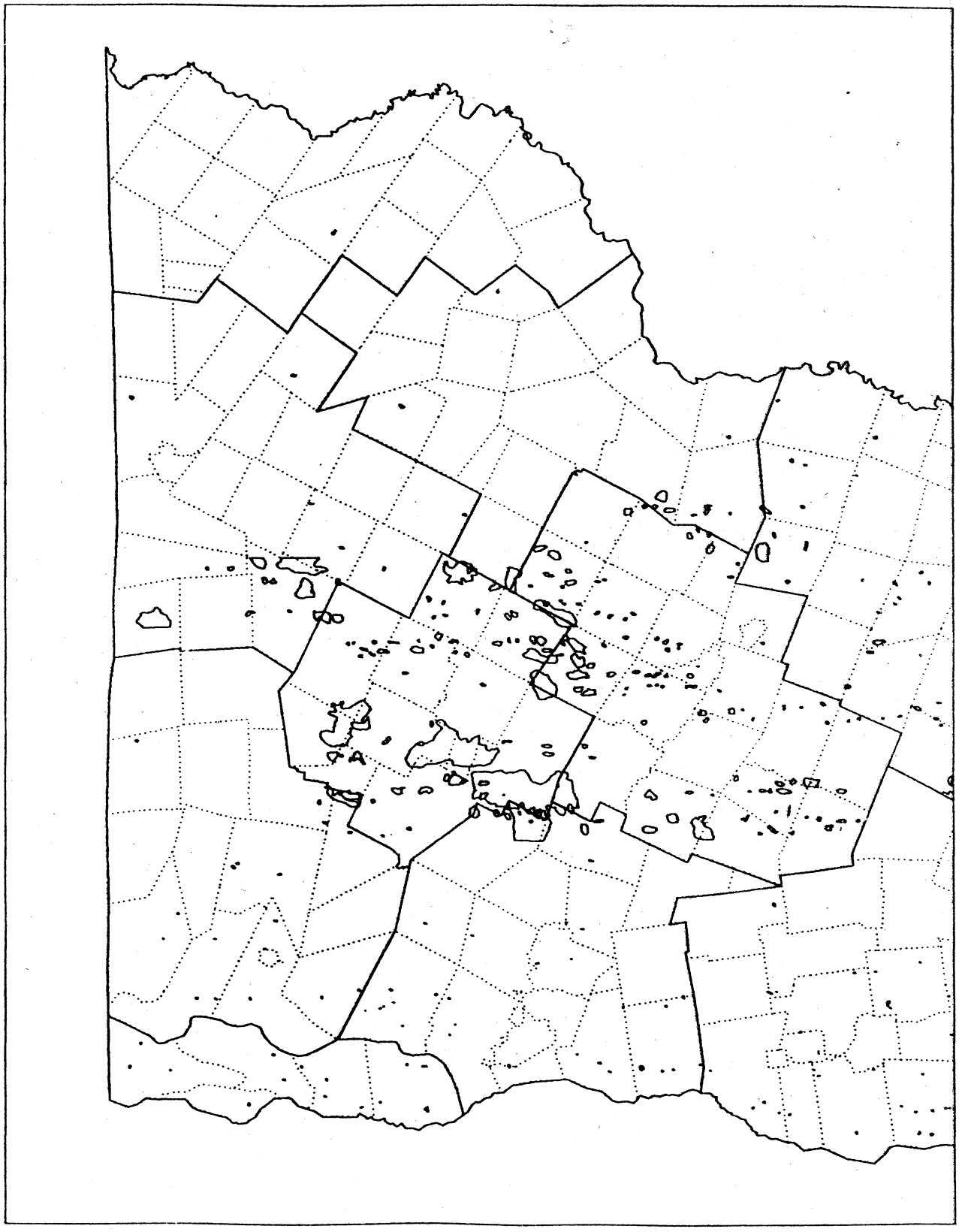
Table 17. Mapped acres of hardwood dieback, mortality, thin crowns, and chlorosis in 1993.

County	Damage Pattern		
	<30% of Trees	>30% of Trees	Total
Addison	170	130	300
Caledonia	2000	180	2180
Chittenden	1510	5160	6670
Essex	0	50	50
Franklin	1460	150	1610
Grand Isle	80	10	90
Lamoille	39050	2130	41180
Orange	830	1560	2390
Orleans	4580	3140	7720
Rutland	90	480	570
Washington	14450	3230	17680
Windham	0	30	30
Windsor	20	440	460
Total	**64240**	**16690**	**80930**

Spruce Mortality, primarily of upper elevation red spruce combined with some balsam fir, was mapped on 2050 acres, compared to 3170 acres in 1992 (Table 18, Figure 21).

Table 18. Mapped acres of spruce mortality in 1993.

County	Acres
Addison	20
Bennington	100
Chittenden	580
Franklin	130
Lamoille	170
Orange	240
Orleans	490
Rutland	70
Washington	220
Windham	20
Windsor	10
Total	**2050**



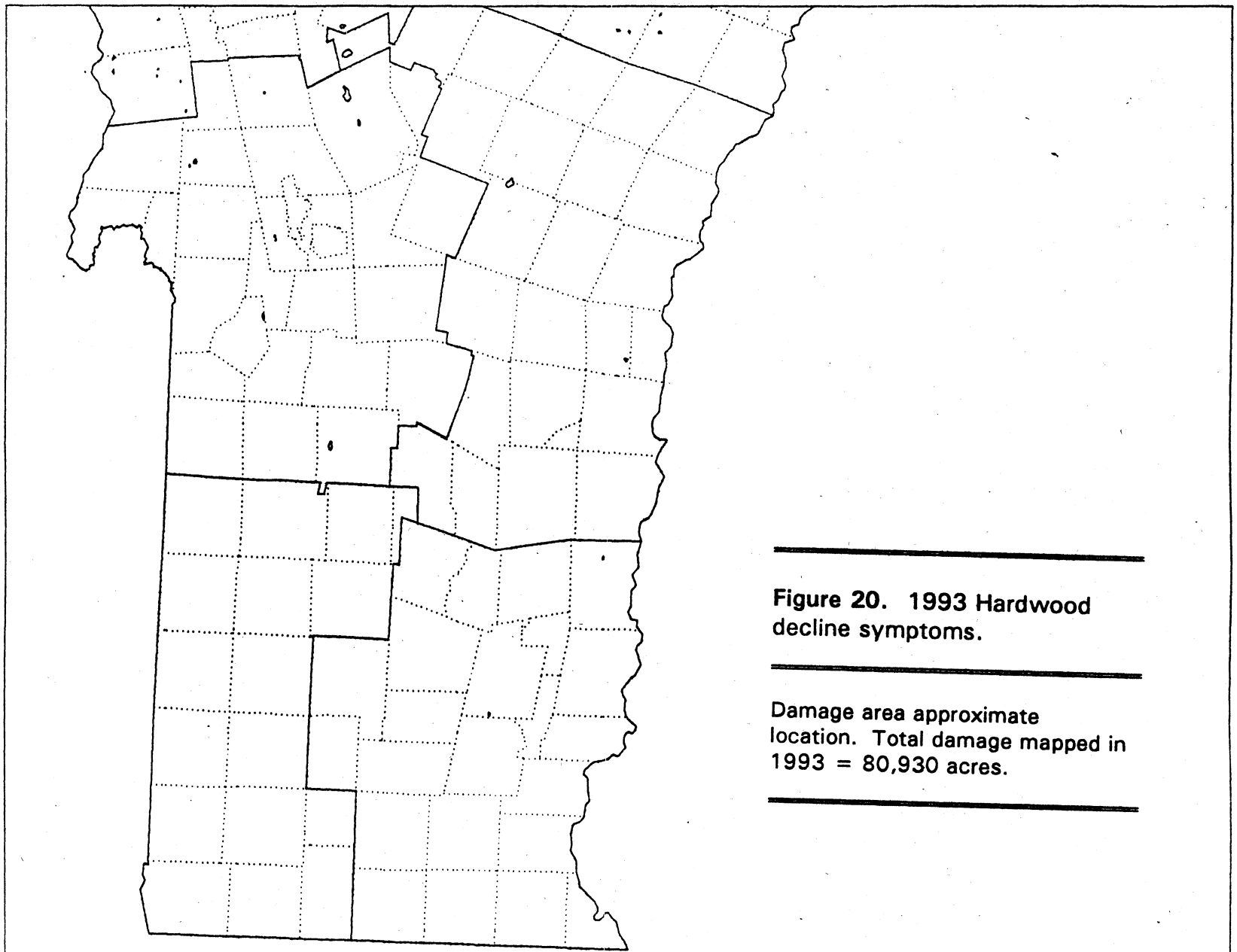
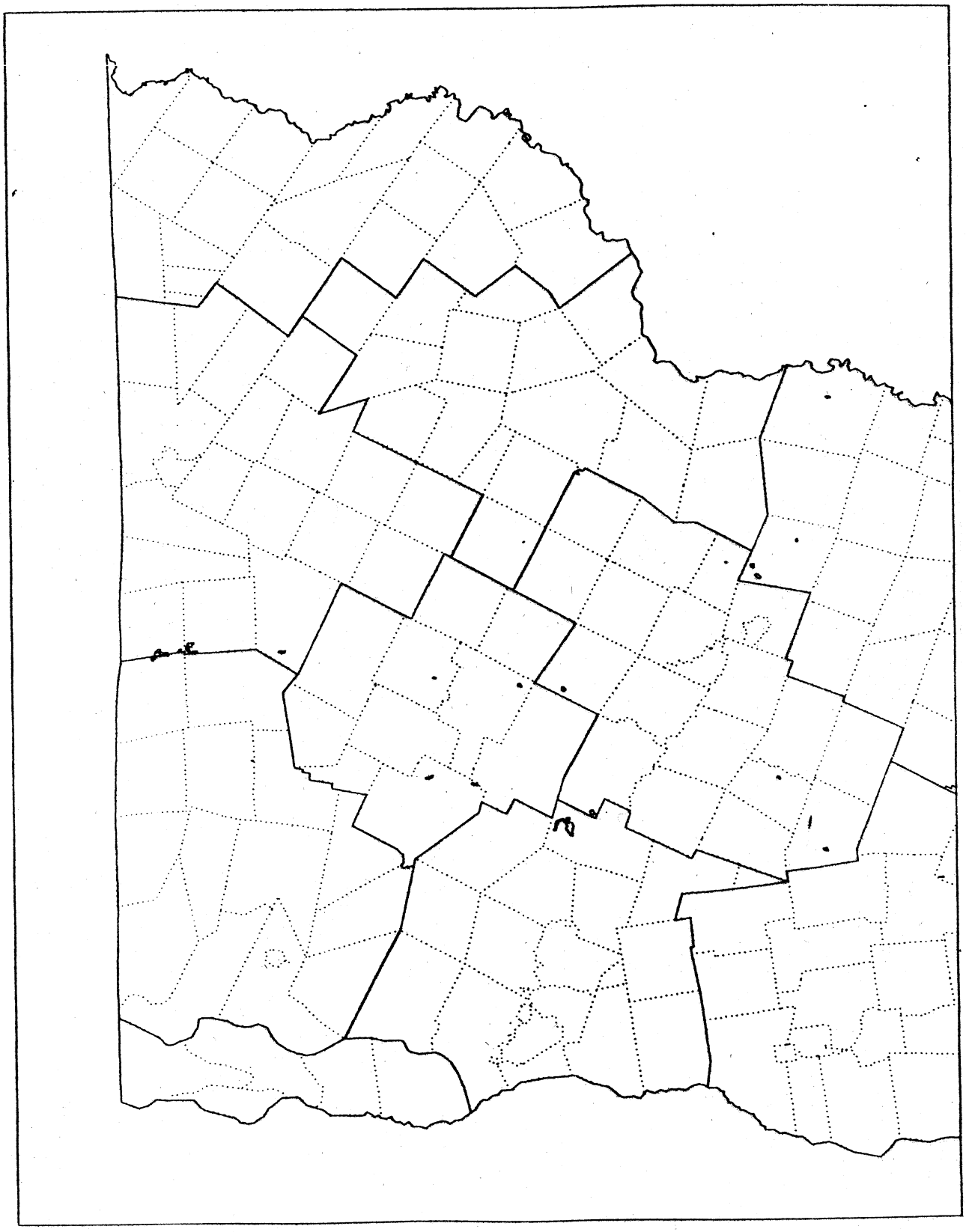


Figure 20. 1993 Hardwood decline symptoms.

Damage area approximate location. Total damage mapped in 1993 = 80,930 acres.



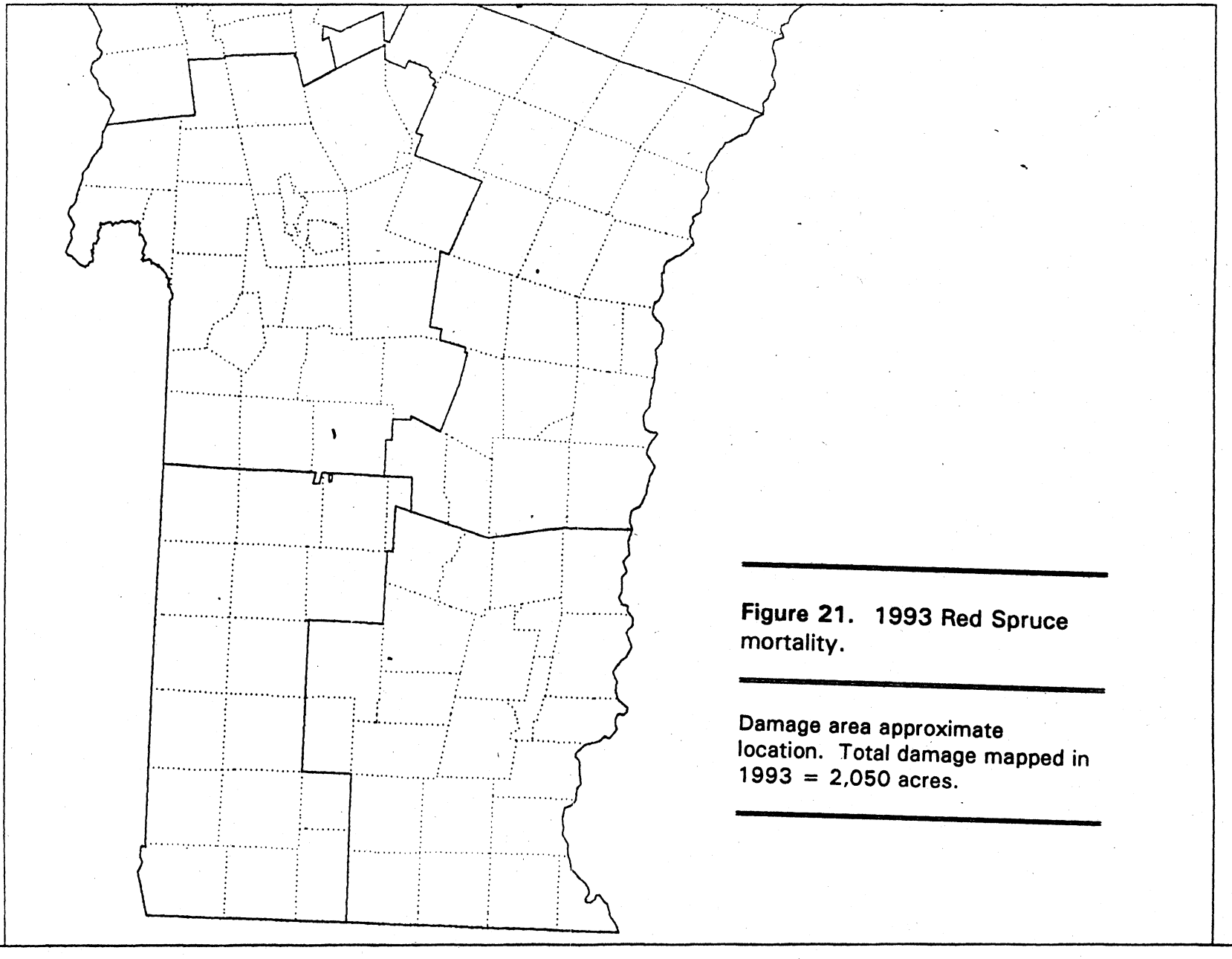


Figure 21. 1993 Red Spruce mortality.

Damage area approximate location. Total damage mapped in 1993 = 2,050 acres.

Wet Site conditions were responsible for mortality of a variety of tree species. Acres mapped increased slightly, with 9060 acres compared to 8120 acres in 1992 (Table 19, Figure 22).

Table 19. Mapped acres of dieback and mortality due to wet site in 1993.

County	Acres
Addison	3370
Chittenden	1020
Franklin	1730
Grand Isle	2220
Lamoille	30
Orleans	20
Rutland	460
Washington	80
Windham	80
Windsor	50
Total	**9060**

Again, most of the acreage was in the Champlain Valley associated with Lake Champlain and its tributaries. Unusually high water levels in the spring of 1993 may contribute to continued decline in these flood-prone areas. Small scattered areas of mortality due to beaver-caused flooding was also evident throughout the state.

Wet site was also the cause of premature needle drop and dieback of balsam fir Christmas trees in several southern Vermont locations.

White Pine Needle Blight, or "Semi-Mature Tissue Needle Blight," symptoms from 1992 were commonly visible in early summer. However, 1993 foliage remained healthy. Last year's symptoms were visible on 340 acres of white pine plantations in the Christmas tree survey, but no damage to 1993 growth was detected. According to one hypothesis, this blight may be caused by a needlecast fungus (unnamed *Pseudovirgella sp.*) which does not produce fruiting bodies until the following spring about the time that new needles are emerging.

Wind Damage was unusually common due to downdrafts from violent thunderstorms and a tornado on September 9 that touched down in West Charleston (Orleans County) and extended to northwestern Brighton (Essex County). This tornado blew down trees in scattered small patches totalling approximately 200-250 acres. Downdrafts from violent thunderstorms blew down hundreds of trees in Stillwater State Park and vicinity in Groton on July 29. A similar storm blew down 5 acres of timber on the north face of Mt. Philo in Charlotte on August 22. Other storms caused similar damage in scattered northern locations.

Damage from a later winter windstorm was the cause of foliage browning and bud mortality on the northeastern side of many Scots pine Christmas trees in a plantation in Shaftsbury.

Winter Injury to red spruce was widespread this spring for the first time since 1984. Damage was mapped on 44,300 acres and occurred at all elevations but was most severe at the higher elevations, particularly above 1500' (Table 20, Figure 23). In ground checked areas, an average of 90% of current shoots on red spruce were affected. Less than 5% of previous year's needles were affected.

Table 20. Mapped acres of winter injury to red spruce in 1993.

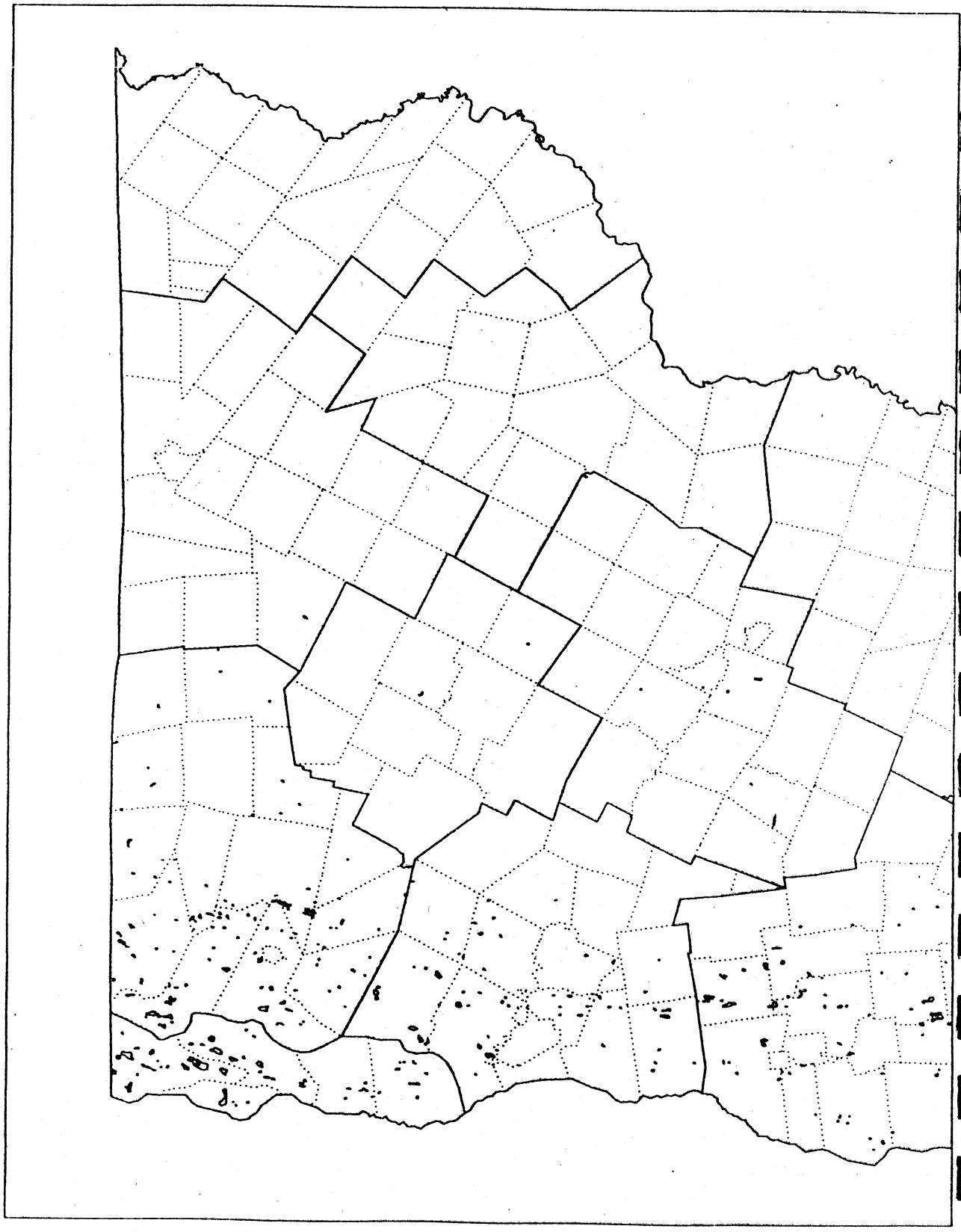
County	Damage Severity			
	Light	Moderate	Heavy	Total
Addison	100	910	1200	2210
Bennington	0	7800	9300	17100
Caledonia	200	370	80	650
Chittenden	750	0	90	840
Essex	0	340	150	490
Franklin	60	0	360	420
Lamoille	60	0	90	150
Orange	190	0	440	630
Orleans	100	190	470	760
Rutland	0	6220	3180	9400
Washington	640	160	110	910
Windham	0	6850	760	7610
Windsor	0	1790	1340	3130
Total	**2100**	**24630**	**17570**	**44300**

Damage occurred to all age classes of trees, but was less severe on regeneration under 2' tall. Not all trees in affected stands had injury symptoms. Damage was often most severe on the southwest side of affected trees and on trees growing on ledgey sites.

Damage was probably related to cold temperatures in February, when 30-35 degrees below zero was commonly reported for many Vermont locations. This followed warm weather in January when spruce may have lost some cold tolerance. Red spruce has less ability to tolerate cold than other native conifers. Temperature extremes in February were probably the lowest recorded since 1981. Winter injury to spruce was common in that year also, but was not mapped.

Damage began to appear with warm weather in late March, with needle drop well underway by mid-April. Although most affected trees produced new shoots normally, browning was still visible at higher elevations in early July. Trees appeared green, although thin, as needle drop continued over the summer. Some bud mortality was observed in Bennington County, where new growth often developed from latent buds, particularly in the mid and lower crowns.

A study on the red spruce winter injury by Julian Hadley of the Harvard Forest found no relation to elevation in the southern Vermont - northwestern Massachusetts region. In this area, average injury to 1992 foliage ranged from 40-50%.



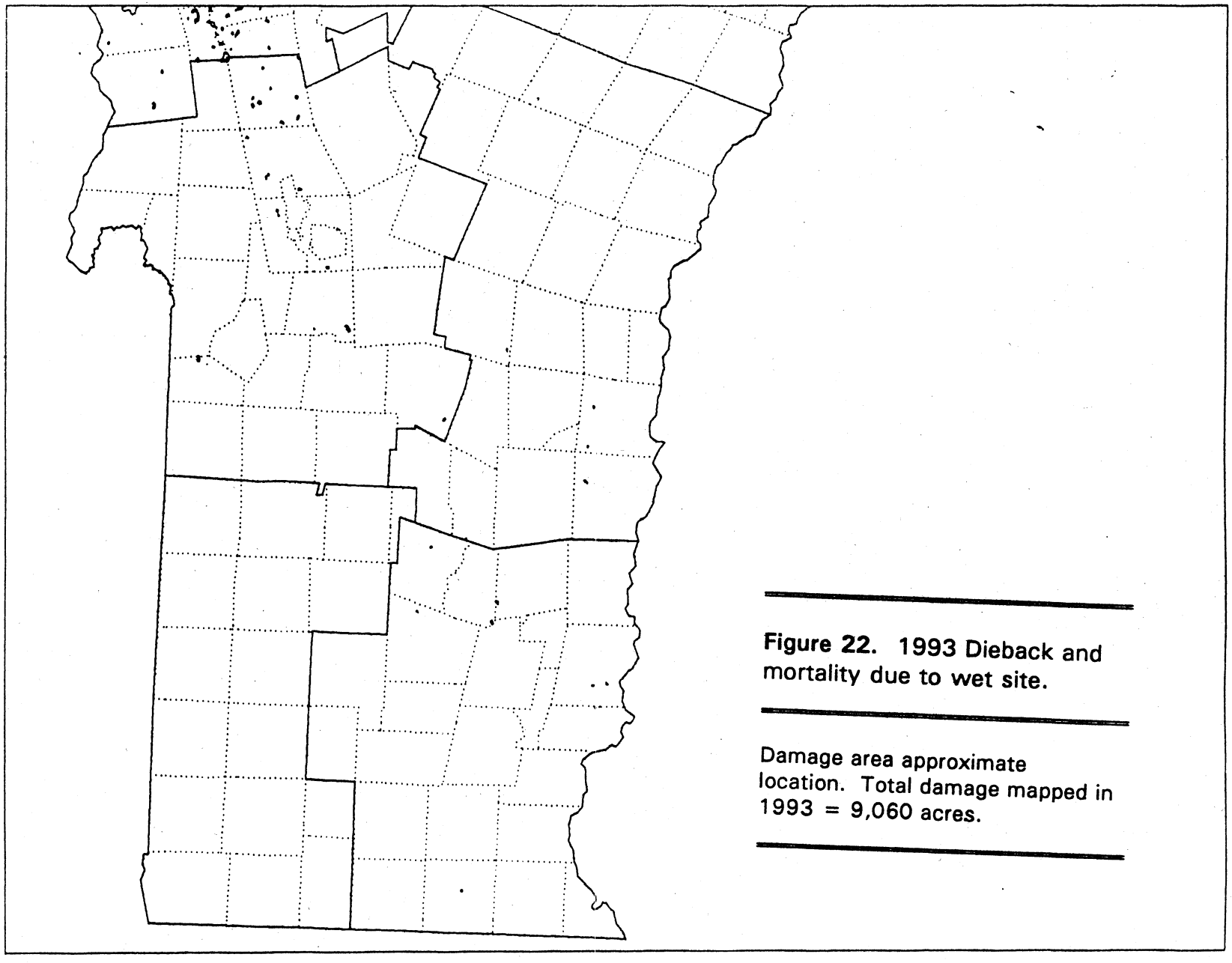


Figure 22. 1993 Dieback and mortality due to wet site.

Damage area approximate location. Total damage mapped in 1993 = 9,060 acres.

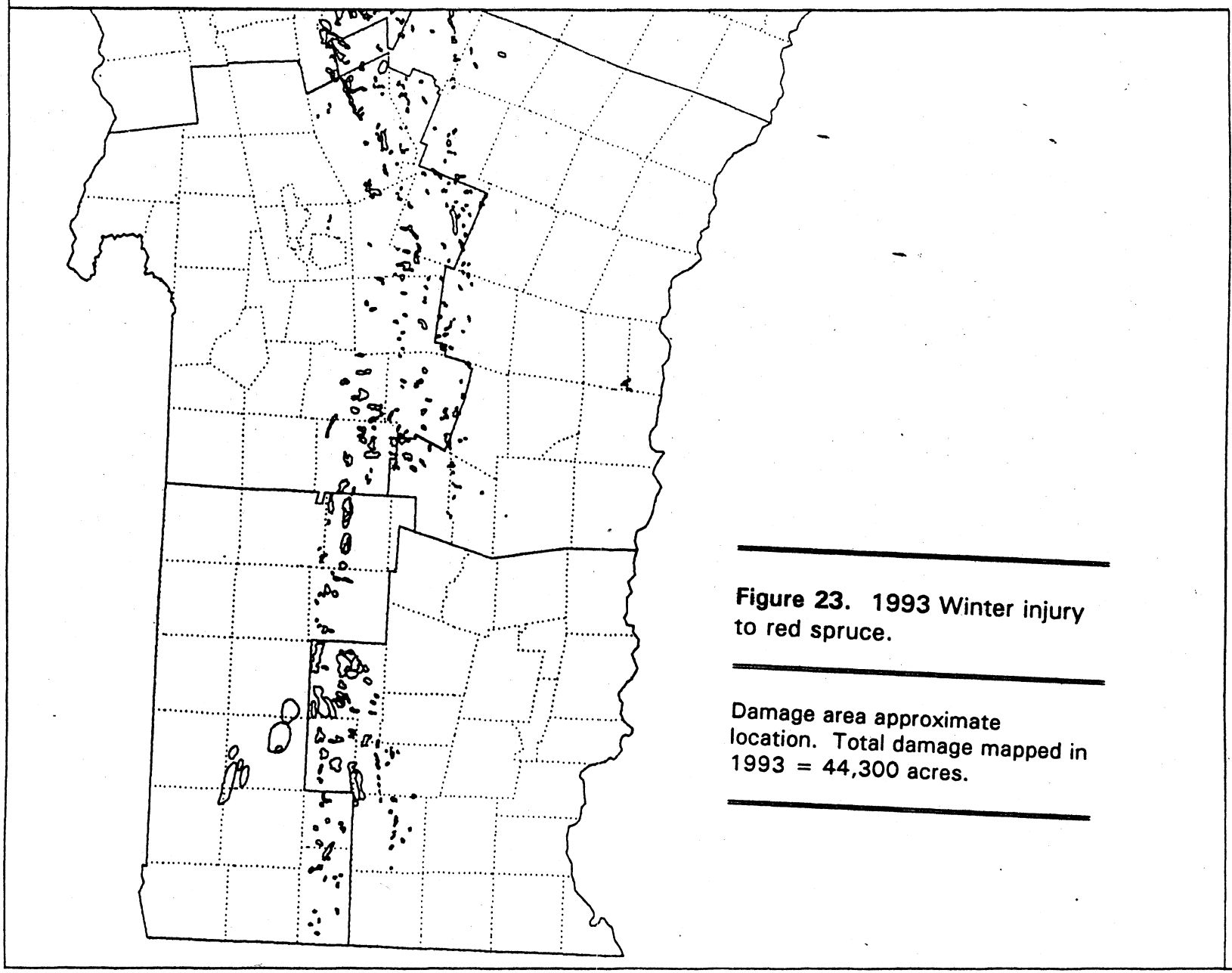


Figure 23. 1993 Winter injury to red spruce.

Damage area approximate location. Total damage mapped in 1993 = 44,300 acres.

Ground plots to assess red spruce browning were established in seven locations. Discolored and missing needles recorded as a percentage of total foliage per tree averaged 12% and ranged from 0 to 40%. The Groton (Owls Head) location had the most needle injury, with 22% of the trees exceeding 20% foliar injury (Figure 24). Bud mortality exceeding 30% occurred in only < 10% of all trees but was especially severe in Warren (Sugarbush), where it was reported for 45% of the trees.

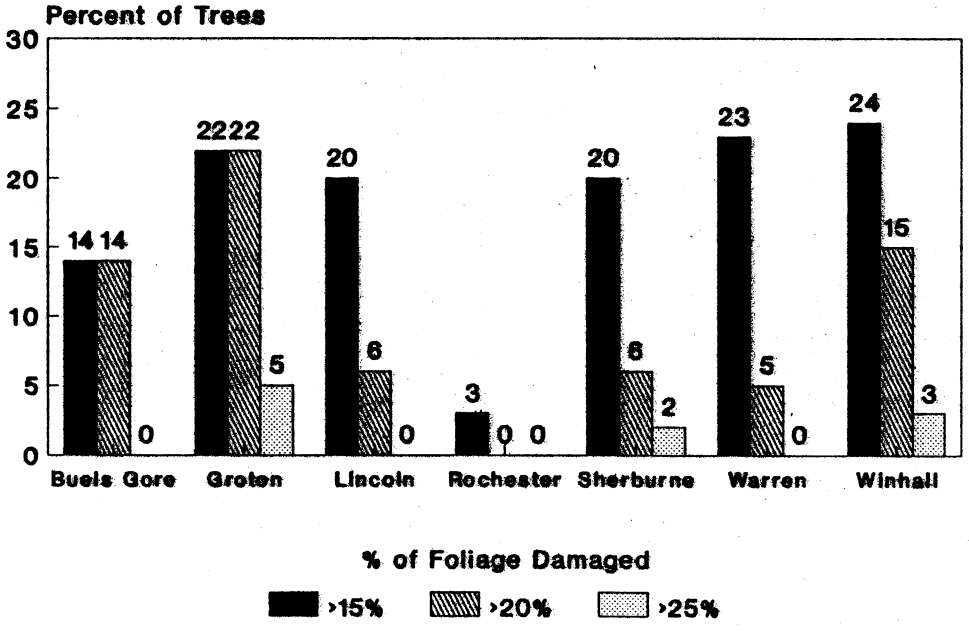


Figure 24. Percent of red spruce with discolored or missing foliage due to winter injury, by percent of foliage damaged, in seven monitoring plots, 1993.

Winter Injury from cold temperatures in February also led to dieback on marginally hardy shrubs in the Champlain Valley and elsewhere such as privet, autumn olive, euonymus, and forsythia. Some trees such as catalpa and black walnut also experienced bud kill, but most recovered almost completely by the end of June.

Some winter injury to Christmas trees occurred but it was mostly limited to scattered fraser fir in exposed locations. One Douglas fir plantation in Windsor County had bud mortality. Over 200 acres of such damage was reported during the annual northern Vermont survey.

OTHER DIEBACKS, DECLINES AND ENVIRONMENTAL DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Ash Dieback			See narrative.
Birch Decline			See narrative.
Bud Abortion			See Winter Injury.
Chlorosis	Balsam Fir	Baltimore Rockingham Shrewsbury Springfield Weathersfield	Chlorosis of current year's foliage developed on occasional trees in early fall. This pattern of chlorosis may occur in some years, stimulated by reduced photoperiod.
Construction	Hemlock White Pine	Hartford Springfield	Mortality from buried roots and other construction-related damage.
Drought			See narrative.
Fertilizer Injury	Grey Birch Maple species	Putney Rockingham	Weed & Feed Fertilizer. Fertilizing too late.
Fire Damage		Addison Chittenden Counties	34 acres mapped during aerial survey.
Frost Damage			See narrative.
Hardwood Decline and Mortality			See narrative.

OTHER DIEBACKS, DECLINES AND ENVIRONMENTAL DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Heavy Seed	Red Maple	Scattered	Led to thin crowns on occasional red maple.
	White Ash		See Ash Dieback.
	Balsam Fir	Tinmouth	Associated with dieback of shade tree.
Hemlock Stand Opening		Pomfret Woodstock	Scattered mortality following thinning, especially where wounding occurred. No recent decline or mortality in a Hartland stand which had mortality in 1987.
Improper Planting		Many	Failures related to planting too deep, girdling roots, and burlap above soil line wicking away moisture.
Insecticide Injury	Balsam Fir	Wheelock	Horticultural oil, applied when new growth was emerging, resulted in foliar bleaching.
Larch Decline	European Larch	Sharon	Cracks, often oozing pitch, and scattered mortality. Similar damage in Wisconsin attributed to frost wounds infected with *Sphaeropsis sp.*
	Tamarack	Scattered throughout	Only 13 acres mapped in Essex and Orleans Counties. Current mortality associated with Larch Beetle in Windham County.
Lightning	Sugar Maple	Newfane	Infected with Armillaria.

OTHER DIEBACKS, DECLINES AND ENVIRONMENTAL DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Maple Decline			See Hardwood Decline.
Mechanical Injury	Ornamental & Roadside	Many locations	Damage from road maintenance and construction is associated with dieback and mortality.
Nutrient Deficiency	Balsam Fir	Springfield	Christmas tree chlorosis was corrected with nitrogen fertilization.
Overtapping	Sugar Maple	Scattered locations	Can be associated with tree decline.
Premature Needle Drop	Hemlock	Fletcher, Elsewhere in Franklin County	Loss of current needles on trees attributed to logging disturbance or excess water from water table change due to high spring run-off.
Salt Damage	Conifers	Roadsides throughout	Unusually heavy browning in spring.
Spruce Mortality			See narrative.
Wet Site			See narrative.
White Pine Needle Blight			See narrative.
Wind Damage			See narrative.
Winter Injury			See narrative.

ANIMAL DAMAGE

ANIMAL	SPECIES DAMAGED	LOCALITY	REMARKS
Beaver	Many	Throughout	Many new ponds have been constructed, increasing flood damage. Continued increase in populations may be due to low trapping pressure.
Deer	Many	Throughout	Heavy browsing around some wintering areas and damage to ornamentals, especially yew.
	Fraser & Balsam Fir Christmas trees	Scattered throughout	Substantial damage in some plantations. Controls used include shooting, fencing, and repellents.
	Red Oak	Green Mountain National Forest	Tree shelters protected seedlings from browsing as well as mouse damage.
Grosbeaks	Balsam Fir	Londonderry	Damage to buds of forest regeneration.
Moose	Mountain Ash Red Maple Striped Maple	Widespread	Heavy damage to regeneration in the Northeast Kingdom. Damage also increasing in north-central Vermont and throughout Green Mountain range.
Mouse (Meadow Vole)	Christmas trees Apple Ornamentals	Northwestern & Northcentral Vermont	Abundant damage reported for the first time since 1975. Many young trees killed. Deep snow cover probably contributed to the problem. 30 acres of heavy damage in Addison and Grand Isle Counties detected by aerial survey.
Porcupine	Many	Widely scattered	Still increasing in Caledonia County but stable or decreasing elsewhere.

ANIMAL DAMAGE

ANIMAL	SPECIES DAMAGED	LOCALITY	REMARKS
Sapsucker	Apple White Birch Sugar Maple Norway Maple Hemlock Norway Spruce Scots Pine White Pine Hybrid Poplar	Throughout	Damage unusually severe to preferred trees in some southern Vermont locations.
Squirrel	Maple Tubing	Scattered throughout	Causing a lot of damage in a few sugarbushes, but fewer complaints than a few years ago.

North American Maple Project -

Sugar Maple

The percent of healthy overstory sugar maples on NAMP plots, based on the amount of recently dead branches, has remained constant over the past five years (Figure 25). The 11 plots added in 1992 had higher dieback ratings than the original 29 plots, but showed little change from 1992 to 1993.

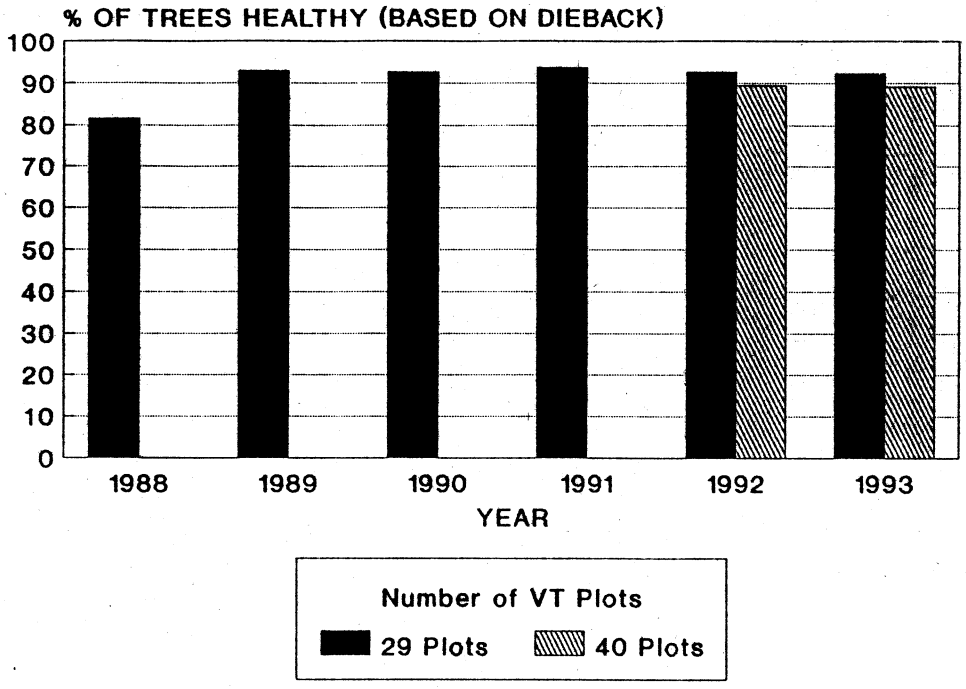


Figure 25. Percent of sugar maples with ≤ 15% dieback in North American Maple Project plots, 1988-1993.

Foliage on sugar maples has been thinner over the past two years, probably due to heavy seed production in 1992 followed by an increase in defoliating insects in 1993 (Figure 26). Defoliation by pear thrips and bruce spanworm this year contributed to thinner than normal crowns in 12% of the plots.

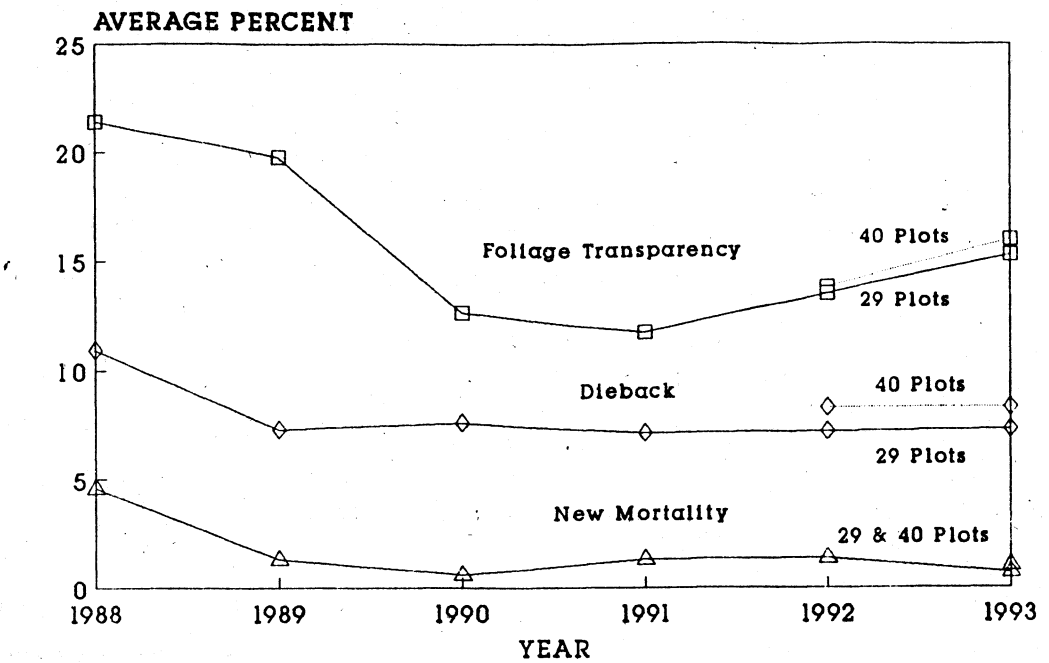


Figure 26. Average percent transparency, dieback and new mortality of sugar maples in North American Maple Project plots, 1988-1993.

New mortality has remained at approximately 1% per year over the past 5 years. Fifteen of the 1,571 tree alive and not cut in 1992 were dead in 1993. Most of these were severely declining in 1992.

Other Hardwood Species

The condition of other species abundant in the overstory on NAMP plots indicates that not all species are as healthy as sugar maples. On the original 29 plots, only ash had a large enough sample size to report trends over the years (Figure 27). But when additional plots were added in 1992, yellow birch, red maple and beech could be included in our reporting.

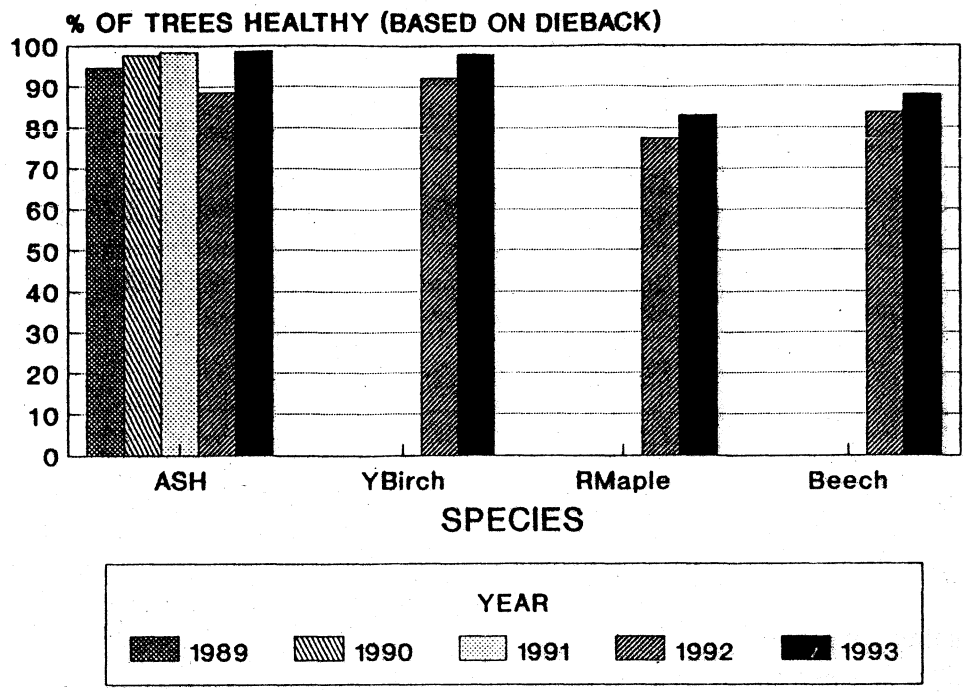


Figure 27. Percent of trees, by species, with ≤ 15% dieback in North American Maple Project plots, 1989-1993.

Ash showed a decrease in the percentage of trees healthy in 1992, but seemed to rebound by 1993. In 1992, ash had a heavy seed production and additional stress from late spring frost, probably accounting for its poor condition. While trees in NAMP plots showed a recovery in 1993, aerial and ground observations in some areas of the state showed continued ill health of ash trees. No new mortality was recorded in 1993.

Yellow birch on NAMP plots improved from the previous year. There was 2% new mortality in 1993.

Red maple, while improving somewhat in 1993, maintained a relatively low percent of healthy trees. Early fall color of red maple was observed in many areas around the state in 1992, indicating stress on this species. Heavy seed crops in 1992 may again be responsible. No new mortality was reported.

More healthy beech trees were reported in 1993, and no new mortality was observed.

Take A Plot - The Take a Plot program for use by landowners wishing to follow the health of their own trees continues. Sixty-three plots have been established since the beginning of the program. Data has been received at least once from 63 plots since 1988. Data from eleven of them has been received annually over the six-year period.

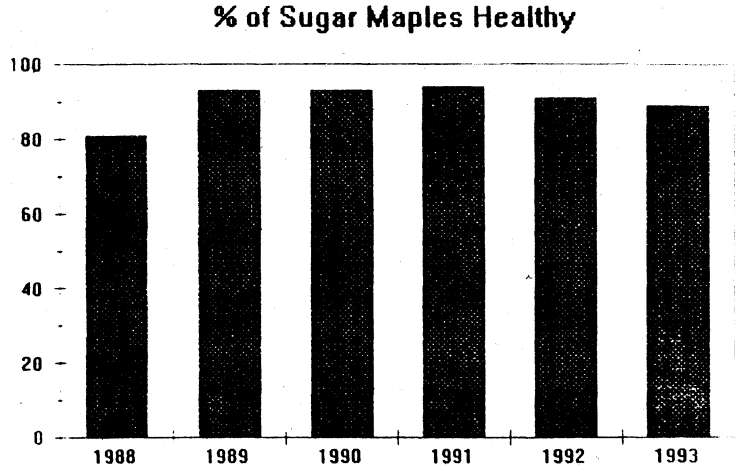
HEALTH OF SUGAR MAPLE IN VERMONT - 1993

Reported by the State of Vermont Department of Forests, Parks, and Recreation

This information on health of sugar maple is based on aerial surveys and field observations by the Vermont Department of Forests, Parks, and Recreation, the University of Vermont and the U.S. Forest Service.

Insect and disease reports, and requests for identification and information on control, should be directed to the County Forester or Forest Resource Protection personnel at our district or county offices. The best way to find out about developing problems is to inspect your sugarbush periodically in the spring and summer for dead twigs, thin or off-color leaves, insects, or chewed off pieces of leaf on the ground. Poor health may be caused by many factors, such as site, crowding, and management practices. If defoliation is occurring, knowing the date of defoliation, and whether or not trees refoliated, will help you determine the effect on tree health. If trees were defoliated, or if there are other signs of poor vigor (like slow taphole closure or dead branches), reduced tapping may help trees recover. You may also want to keep track of changes in the health of your trees by establishing a monitoring plot using the Take-A-Plot kit.

General Health of maples remained good this year, although drier conditions in 1992 and 1993 led to thinner crowns, particularly where trees were already stressed or growing on poor sites. Trees which are part of the North American Maple Project (the international effort to follow changes in maple health) were slightly less healthy than in the past four years. The percent of overstory sugar maples with little or no dead twigs and branches decreased from 91% in 1992 to 89% in 1993 (see graph). Defoliation by pear thrips and bruce spanworm contributed to thinner than normal crowns in a few of the monitoring plots.



Pear Thrips caused more damage in 1993 than it had in any year since 1988. All of the heavy defoliation was in the northern part of the state, mostly at upper elevations, where 80,000 acres of damage were mapped from the air. This is probably because warm weather in early spring resulted in rapid leaf flush on southern Vermont and low-elevation trees, while those at northern, upper elevation sites were just breaking bud when the cool weather returned. Heaviest damage occurs when the thrips are able to feed within the leaf buds.

Many trees had severe damage, with such small leaves that they dropped them and put out new ones. This refoliation occurred rapidly due to ample rainfall in early June. This is good news for the trees and suggests that they were not as stressed by the damage as those damaged by thrips in 1988, when a severe June drought delayed refoliation. Moderately damaged trees (30-60%

defoliated) tend to retain the stunted leaves for the rest of the growing season, and therefore may be as stressed as those which are heavily damaged and then refoliate. Sugarmakers should consider reducing taps on damaged trees.

The heaviest thrips damage occurred in counties where numbers of thrips in the soil in fall '92 were the highest. Soil samples were taken again in the fall of '93, from a number of sugarbushes throughout the state, to determine how high thrips populations will be next spring. These samples are currently being analyzed at the University of Vermont. Sugarmakers who would like to sample their own sugarbushes may do so by collecting several soil samples with a bulb planter, when the ground is not frozen, and allowing thrips to emerge from the soil in a closed container with a clear sticky top. Instructions about this procedure and interpreting results can be obtained from the University of Vermont Entomology Lab at 658-4453.

Maple Leaf Cutter damage was up from 1992. Again, the most damage occurred in Caledonia, Orange, and Windsor Counties, with scattered damage elsewhere. Because this insect can persist in the same area for some time, tree stress can be significant, even though the damage occurs late in the season. Next year's damage will be determined, in part, by how well the insect survives the winter in the soil. For sugarbushes which have been defoliated, sampling in early June can determine whether populations are high enough to cause defoliation again in 1994.

Bruce Spanworm defoliation was seen throughout the state in late spring, although heavy damage was only seen occasionally. Several sugarbushes in Caledonia County were moderately defoliated. This insect is a light green inchworm, whose feeding makes leaves look lacey (see photo). The damage can be distinguished from pear thrips damage, which also shows up early, because thrips damaged leaves are also crinkled and mottled. Additional Bruce spanworm defoliation is expected in 1994, because moths were commonly seen in the fall.

Hardwood Decline and Mortality continued to be evident in scattered locations, and was mapped on 80,000 acres. Ground checks indicated that symptoms were related to drought stress in some of these areas, while in others, the main problem was ash dieback, rather than maple decline.

Miscellaneous: Anthracnose, a fungus disease causing browning of maple leaves, was observed occasionally in the Champlain Valley. Galls on leaves, caused by microscopic mites, were common throughout the state, but their impact on tree health is negligible. Forest Tent Caterpillar and Saddled Prominent populations remain very low.

COMMON PESTS OF CHRISTMAS TREES IN VERMONT 1993
REPORTED BY THE
DEPARTMENT OF FORESTS, PARKS AND RECREATION

INTRODUCTION

A survey is conducted annually on nearly 400 acres of Christmas tree plantations in North-Central Vermont as part of the Scleroderris quarantine. Observations are made on all pests during this survey. Acreage comparisons reported for Christmas tree problems refer to changes in these surveyed plantations and are not statewide totals.

INSECTS

Balsam Gall Midge populations remain low. During the annual northern Vermont Christmas tree survey, only one balsam fir plantation had noticeable needle gall damage, and it was light. No damage is expected in 1994.

Balsam Shootboring Sawfly caused light to moderate shoot top mortality on 329 acres of balsam and fraser fir in northern Vermont compared to 93 acres in 1992. Fraser fir received 129 acres of the damage. All but 59 acres of the total damage reported was light. Damage is likely to increase in 1994.

Balsam Twig Aphid damage was detected on 283 acres of fir in northern Vermont but most of this was light, compared to mostly moderate damage in 1992. Populations appeared to be heavier in southern Vermont where scattered heavy damage was observed. Northern Vermont populations appeared to be crashing by mid-summer, as it was difficult to find any aphids within damaged foliage. Overwintering eggs are also scarce in the few northern plantations sampled but can be easily found in some southern plantations. Overall damage should be much reduced in 1994 but this aphid may remain a problem in some plantations, particularly those in Addison County or the most southern four counties. Growers may wish to have their trees checked for overwintering eggs to determine control needs for 1994.

Cooley Spruce Gall Adelgid populations increased, with 109 acres of damage to Douglas-fir reported for northern Vermont. Nearly half of this damage was classified as heavy.

Cinara Aphids were observed on some young spruce Christmas trees in Fletcher and some white pine Christmas trees in Rockingham but these insects were less frequently seen than in past years.

Eastern Spruce Gall Adelgid damage, mostly to white spruce, increased in northern Vermont Christmas tree plantations, with 160 acres of light to moderate damage detected compared to 34 acres in 1992. Elsewhere, damage appeared to be common but stable.

Mound Ants were responsible for scattered mortality of balsam fir in Townshend and Clarendon.

Pales Weevil damage was down again this year, with only occasional individual trees in Christmas tree plantations exhibiting damage during the annual survey of northern Vermont plantations.

Pine Leaf Adelgid injury to white pine shoots was noticeable in areas that had moderate to heavy populations of adelgids in 1992 but no insects were detected this year.

Pine Needle Midge showed a marked increase this year, with 266 acres of damage to Scots pine reported for northern Vermont. Look for needles that bend downward from the fascicle and then droop, with damage most noticeable at the tops of trees.

Pine Spittlebug was more commonly observed on Scots and white pine than in 1992 but damage was light on the 99 acres detected in northern Vermont.

Pine Thrips damage was not detected this year.

Ragged Spruce Gall Adelgid damage to red spruce remains common.

Sawyer Beetles caused moderate balsam fir shoot mortality to a 20 acre plantation in Stannard and light damage to a 25 acre plantation in Brookfield. Recently cut conifer logs and slash were present in both plantations. This serves as breeding material for the insect. Adults emerge in early summer and feed on the undersides of shoots.

Spruce Spider Mite populations appeared to be increasing in balsam and fraser fir plantations by late summer. In most locations, 1993 damage was only light but overwintering eggs appear to be plentiful. Growers should inspect their trees in June, 1994, for the presence of tiny reddish mites.

White Pine Weevil damage was more noticeable this year than in 1992. A total of 510 acres of pine and spruce was reported damaged this year compared to 78 acres in 1992. As usual, white pine received the most damage (289 ac), but blue spruce (117 ac) and Scots pine (88 ac) also were commonly attacked.

White Grubs were found to be destroying the root systems of one-year-old balsam fir trees planted on former agricultural land in Berkshire. The field had not received any weed control since the trees were planted and heavy turf around the trees undoubtedly contributed to the problem.

DISEASES

Cylaneusma Needlecast (formerly *Naemacyclus)* of Scots pine increased, with 280 acres of damage reported for northern Vermont, compared to 71 acres in 1992. Most of this damage (242 acres) was light. Moderate damage was also reported for a Clarendon plantation. If 1994 is a wet year, this damage is likely to increase.

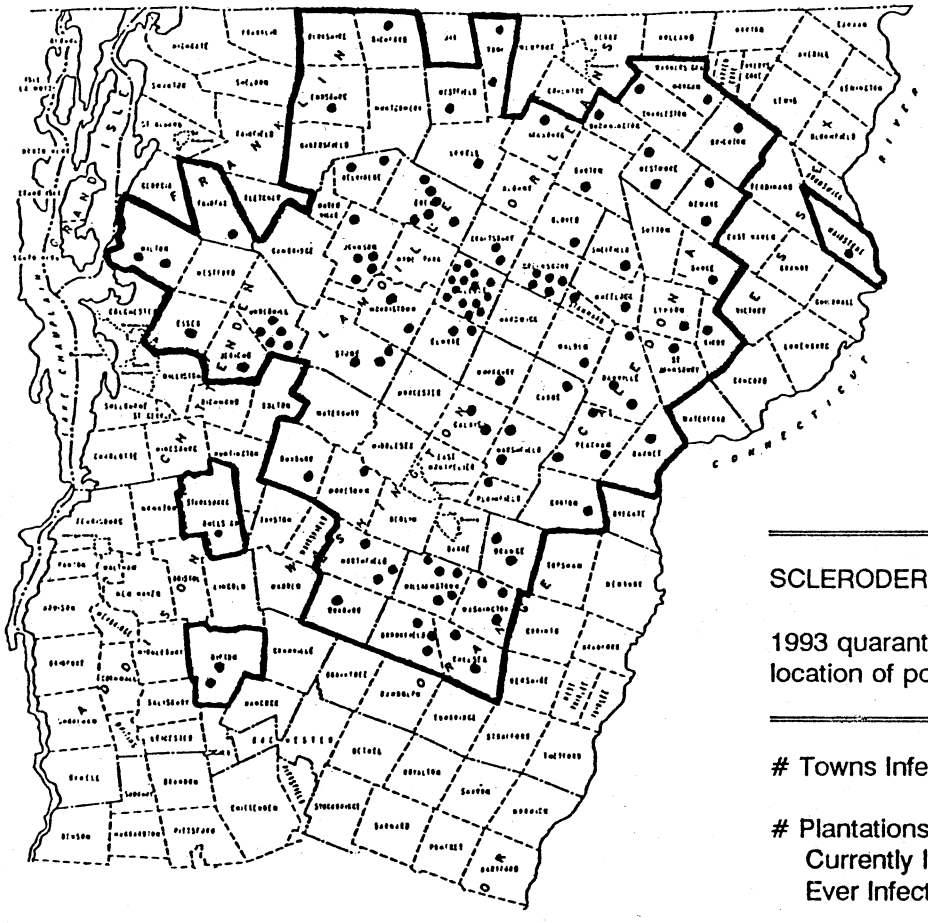
Fir-Fern Rust continued to increase, with 314 acres of damage to balsam and fraser fir this year compared to 121 acres in 1992. Mostly light needle loss occurred but 95 acres had moderate damage. Eliminating sensitive fern, the alternate host, is the best long-term solution to controlling this disease.

Lophodermium Needlecast of Scots pine also increased this year, with 345 acres (239 ac - light) of damage reported compared to only 38 acres in 1992. Many of these pine plantations also have *Cylaneusma* present.

Rhabdocline Needlecast increased over 1992 levels, causing light to moderate needle lose on 104 acres of Douglas fir. This disease is so well established in many of the plantations that only current year needles remained on the most susceptible trees.

Rhizosphaera Needlecast of blue and white spruce, as with the other needlecasts, increased this year, with 226 acres damaged. Damage was light on 142 acres, moderate on 80 acres, and heavy on 4 acres. Most of the injury was on blue spruce, with only 32 acres of white spruce lightly infected.

Scleroderris Canker has not been found in any new towns since 1986. Fifty Christmas tree plantations within the quarantine zone were inspected this year and found free of the disease.



SCLERODERRIS CANKER

1993 quarantine area and location of positive infection

Towns Infected = 64

Plantations:
Currently Infected = 126
Ever Infected = 130

Shoestring Root Rot *(Armillaria)* was responsible for killing Christmas trees in plantations in Wheelock and Stannard where remains of old stumps were serving as infection courts for the fungus.

Sirococcus Shoot Blight was responsible for moderate mortality of white spruce shoot tips in a 4 acre Walden plantation and was common elsewhere at very light levels.

Swiss Needlecast of Douglas fir also increased, with 112 acres of moderate to heavy infection reported for northern Vermont. This disease is more common than Rhabdocline in northern locations but between the two needlecasts, most Douglas-fir plantations throughout the region are degraded.

White Pine Blister Rust damage increased this year, with 245 acres of light damage, 125 acres of moderate damage, and 55 acres of heavy damage, for a total of 424 acres affected. Only 62 acres of light damage was evident in these plantations in 1992.

White Pine Needle Blight, also called Semi-mature tissue needle blight, was visible on 340 acres of white pine plantations due to damage in 1992 but no damage to 1993 growth was detected. This disease is now thought to be caused by a needlecast fungus (new unnamed species).

Woodgate Gall Rust damage to Scots pine was light to moderate on 238 acres compared to 82 acres in 1992.

Yellow Witches Broom Rust of balsam fir was found within 190 acres of balsam and fraser fir plantations. This was usually limited to just a few trees per plantation with one or two small brooms. In most cases, the brooms can be removed from the tree and the tree will recover to a normal density in another growing season or two.

Chlorosis of current year's foliage developed on occasional balsam fir trees in southern Vermont in early autumn. This pattern may occur in some years, stimulated by reduced photo-period (too many cloudy days).

Winter injury was common on scattered fraser fir growing in exposed locations in northern Vermont. Over 200 acres of damage was detected during the annual survey.

Bud Abortion of Douglas-fir was evident in a Springfield plantation, particularly on the south side of scattered trees. This may be due to extreme cold winter weather between mid-February and mid-March.

Foliar Bleaching of balsam fir resulted from an application of horticultural oil in two Wheelock plantations. Applications

were made when new growth was emerging in an attempt to control twig aphid. Trees closest to the sprayer were the most damaged. Oils should be avoided when new growth is tender. For oils to be effective against aphids and mites, thorough coverage is essential. This is difficult to obtain on tightly sheared trees.

Frost Damage was much reduced from recent previous years. Frost injury was reported on 452 acres but most of this (407 acres) was light. Balsam fir was the species most affected with 214 acres of visible damage, followed by white spruce with 72 acres.

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